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AN

ESSAY

ON

Comparative Anatomy.

[illegible]
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—Vos minime fugit, plures eſſe humani corporis partes, quarum ſtructura, & officium, etſi non aliunde quam ex beſtiis deſumpta ſint, nunc tamen in Scholis accipiuntur, atque probantur.

Ant. M. Valſalva in diſſert. Anatom. tertia.

Incidenda autem animalia, quibus partes illae, quarum actiones quaerimus, eaedem atque homini ſunt, aut certe ſimiles iis; ex quibus ſine metu erroris judicare de illis hominis liceat. Quin & reliqua, ſi modo aliquam habeant ad hominem ſimilitudinem, quantulacunque ſit, idonea ſunt ad aliquid ſuppeditandum.

Albini Praeſ. ad Harvei Exercitationem de motu cordis.

The SECOND EDITION.

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to His MAJESTY.
MDCCLXXV.

ADVERTISEMENT TO THE READER.

THE following Sheets were found among the Papers of a Phyſician lately deceaſed, and ſent by a Friend of his to the Bookſeller, with Liberty to print them. As the Subject appeared uſeful, they were preſented to two eminent Phyſicians in Town for their Approbation: One of them was ſo good as to write the following Letter, which with Difficulty we obtained leave to print, as it will ſerve for a Preface to the whole. From what he there ſays, in relation to the Subject and Treatiſe, we preſume, the publiſhing it muſt be a Service done the Public.

* * *

A
LETTER, &c.

SIR,

I *HAVE read over the Papers on* Comparative Anatomy, *which I now return you with Thanks by this Bearer. You deſire my Thoughts on the Subject and Treatiſe, and indeed the Pleaſure I had in the Peruſal makes your Demand but juſt.—What is called* Comparative Anatomy, *was certainly the firſt Branch of the Science that was cultivated, and from it the earlieſt Anatomiſts formed their Notions and Syſtem of the human Body. The natural Prejudices of Mankind, and in ſome Senſe common Humanity oppoſed any Attempts to be made in the other Way. As the firſt Phyſicians were Philoſophers, and this part of Natural Knowledge more immediately related to Medicine, they particularly applied to it.* Democritus, *who, accord-*

ing to ſome, was the Maſter of Hippocrates, *ſpent much Time in diſſecting Brutes and examining their ſeveral Parts. He applied himſelf with ſuch Eagerneſs to this Study, as to incur the Cenſure of Madneſs. His Deſign was to examine* the Nature of the Bile, and learn the Seat and Cauſes of Diſeaſes. *That this Science was much improved by the Times of* Hippocrates, *is very apparent from his Writings, which are intermixed with Reaſonings drawn from it, and ſome Parts of his Phyſiology are only applicable to Brutes. Theſe Paſſages appear to us exceeding obſcure, often falſe and contradictory, and have for that Reaſon been rejected by ſome very great Critics.—But is not this owing to our own Ignorance? We do not well underſtand the then received Syſtem of Anatomy, and his Terms and Names do not correſpond to ours. The ſmall Tract* de Vulneribus Capitis, *is I think as great a Maſter-piece in it's kind as the* Coacae Praedictiones. *Yet the firſt has been eſteemed by ſome lame and imperfect; and afforded Occaſion for many*

Diſputes and Wranglings, and all this becauſe not underſtood: Anatomiſts however have done by Hippocrates *in moſt Caſes as the Critics with* Homer, *made him the Maſter of all human and divine Science. Not a new Diviſion of a Bone, or Diſpute about a Proceſs or Articulation, but has been referred to his Judgment, and he has often been made to explain what he never dreamed of.* Galen, *the Father of Anatomiſts, is for the ſame Reaſon in many Places become an obſcure Writer. He is accuſed and defended by the greateſt ſucceeding Maſters.* Veſalius, *the great Reſtorer of Anatomy, will not allow Accuracy or Truth in many of his Deſcriptions; they are according to him taken from Brutes and obtruded on the World for* human.

The other Anatomiſts treat Veſalius *much in the ſame manner, and with uncommon Sagacity and unwearied Application have found out Variations and* Luſus Naturae *in particular Parts, that they may eſtabliſh* Galen'*s Deſcriptions and condemn thoſe of* Veſalius'*s.*

This is particularly the Caſe with Euſtachius *in his Treatiſe on the Kidneys. How ſhall we now underſtand* Galen, *and judge between theſe great Anatomiſts?— 'Tis* Comparative Anatomy *alone can extricate us from this Confuſion, as it will teach us, when* Galen *and others deſcribed and reaſoned from Brutes, and when not. We ſhall then find (I believe) that the greateſt Part of his Deſcriptions was taken from Brutes, which he transferred by Analogy to the human Body, and ſo are inaccurate; that a few were taken from the human Subject, and are not capable of being otherwiſe applied. This Study he himſelf recommends with great Earneſtneſs to his Scholars, and it is obſervable that the moſt eminent Anatomiſts firſt diſcovered their Genius, by an early Attachment to it. This was particularly the Caſe of* Veſalius *and* Valſalva [a].

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[a] Gaudebat enim Avicularum, aliorumque Animalculorum diſſectionibus, eorumque exta curioſius, quam pro illa aetate, rimabatur: quam ego praeſignificationem, non in Veſalio tantum, ſed in aliis quoque Pueris fuiſſe ſcio, qui, cum adoleviſſent, Anatomiae penitus ſe dediderunt. *Morgagni Comment. de vita Valſalvae.*

As the firſt Knowledge the Antients gained in Anatomy was from the Diſſection of Brutes, ſo they formed the Names and Terms of Art from the moſt natural Appearance the Part afforded, and that in different Animals. Thoſe Names were applied to the correſponding Parts in the human Body, and retained by ſucceeding Anatomiſts to avoid a Multiplicity of Words. This however produces one bad Effect, that it muſt miſlead us in our Conceptions, as thoſe Names are often very improper Epithets in the human Subject. The Author has elegantly remarked ſeveral of theſe. The Name of right and left Ventricle *is apt to give a wrong Idea of the Poſition of the Heart, and the* Aorta aſcendens *and* deſcendens *has impoſed on ſome of the Maſters in Anatomy, who it's plain have taken their Figures from the* Name. *Diſputes have ariſen about the* Appendix Vermiformis, *&c. which are all cleared up when we once view the Part in the Animal whence the Name was taken. A ſhort Technical Dictionary, with an Account of the*

the Subjects whence the Names of the ſeveral Parts were derived would be of great Uſe to Students, and is one of the Deſiderata *in Anatomy*[a].

The Intention of Nature in the Formation of the different Parts, can no where be ſo well learned as from this Science; that is, if we would underſtand Phyſiology and reaſon on the Functions in the animal Oeconomy, we muſt ſee how the ſame End is brought about in other Species.—We muſt contemplate the Part or Organ in different Animals, it's Shape, Poſition, Connexion with the other Parts, &c. *and obſerve what thence ariſes—If we find* one common Effect *conſtantly produced, though in a very different Way, then we may ſafely conclude that this is the* Uſe *or* Function *of the Part; this Reaſoning can never betray us, if we are but ſure of the Facts. The Writers in Phyſiology have generally taken another Rout, and one favourite* Theſis

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[a] Such a Treatiſe might in a great meaſure be collected from *Sylvius*'s *Works*, and *Foetius*'s *Oeconomia Hippocratis*. *Camerarius* did ſuch a Work under the Title of Διασκευὴ ὀνομαστικὴ, but it is a rare Book.

or other ſerves to explain the whole or moſt of the Syſtem. An innate *and* concocting Heat, Acids, Menſtruums, &c. *have all had their ſucceſſive Reigns and Patrons. And in Truth, Phyſicians ſeem not to have ſufficiently conſidered the Importance of this Study to form a complete Phyſiology, which muſt ever be the great Baſis of their Art. They have beſtowed Pains in examining the human Body, diſſected minutely it's ſeveral Parts, traced out (perhaps often invented) a new Diviſion of a Muſcle;—but how little has Phyſick been promoted by all this? The moſt accurate Deſcription of the human Stomach, with all it's Veins, Arteries, Nerves,* &c. *will never rightly explain Digeſtion.—What muſt we then do?—examine it in the other Species of Animals, mark there it's Differences and the Effects, compare theſe with the human, and then ſhall we in ſome Meaſure be able to judge, what are the principal Inſtruments and how they are imployed in this compound Action. Any other Way of Reaſoning (as the Author well obſerves) will never bring*

bring us to the Solution of a Philoſophical or Medical Problem. It muſt indeed be confeſſed, that this Method is tedious and ſlow; many Obſervations muſt firſt be made, and the Labour of ſearching and examining gone through, before we can have proper Materials to build on. Yet theſe are the hard Conditions on which the Knowledge of natural Cauſes is to be obtained, which, as a great Genius ſays, Tàm facilè ſolertiâ vinci poſſunt, quàm ſolent conatibus vulgaribus difficulter cedere.

Of this kind of Reaſoning, we have many beautiful Inſtances in the following Papers; ſuch is the Account of the Poſition of the Duodenum, *the Hiſtory of the* Thymus *and* Thyroeid Gland, *their Uſe and mutual Proportion, the Uſe of the* Spleen, &c. *This laſt he explains in ſo ſhort and maſterly a manner, as you'll find more Argument in the few Lines upon it, than is to be collected from whole Treatiſes on the Subject. But as his Deſign was to give a Deſcription of the ſeveral Species, or rather their principal Differences, he chiefly confines himſelf to this:*

this: So in the Anatomy of the Dog he compares the different Poſition, Shape, Length, &c. *of the ſeveral Parts with the correſponding Parts in Man, and from that one Circumſtance, the* Difference *of an erect and horizontal Poſture, explains all the Variations. This Reaſoning then gives Solution to many Difficulties in the human Anatomy; why the* Spleen *ſo firmly attached to the* Diaphragm, *why the* Omentum *reaches only ſo far, why the poſterior Part of the* Bladder *only covered by the* Peritonæum, &c.—— *There have been Diſputes about the* Fiſſure *in the human* Liver, *and different Accounts given. Theſe all vaniſh, when we conſider this* Viſcus *in different Animals. We then find that there are more or fewer Diviſions, according to the greater or leſſer Flexility of the* Spine. *The ſame Rule holds with regard to the Diviſions of the* Lungs. *This Reaſoning likewiſe excludes the pretended Uſe of the* Ligament *in the human* Liver. *And in ſhort we can underſtand but little of our own Structure, unleſs we ſtudy that of other Animals; we ſhall then find that*

that the ſeveral Variations are relative *and depend on the different Way of Life; that is, one leading* Speciality *draws after it a great many more, in which Nature is always an Oeconomiſt and takes the ſhorteſt Rout.*

The beautiful Gradation *of Nature in the different Orders of Beings, is very remarkable, and ſtrikes the Mind firſt, as being moſt obvious; but when we take any one Species, the Caſe there is ſtill the ſame, and we obſerve as ſurpriſing a Difference. Thus in the Animal Kingdom, ſome are provided with* Lungs, *when others are deprived of theſe breathing Organs; ſome have a muſcular* Diaphragm *and ſtrong* Abdominal Muſcles, *others a mere* Membrane; *ſome have* Lacteals, *others want them. It muſt be very entertaining to learn how theſe Differences and Deficiencies are adjuſted and ſupplied; 'tis then from this Science alone we can underſtand that* Simplicity *of Nature, which is much talked of, and but little underſtood. Hence likewiſe we muſt learn what to think of Animals* perfect *and* imperfect.—

Anatomiſts have made a Noiſe about the different Structures of the ſame Part in the human Body, and been at great Pains to make Collections of thoſe Luſus Naturae *as they call them; which, becauſe they are rare, are for that very Reaſon of no great Conſequence to be known. The Epithet however is extremely proper; for the moſt remarkable of them are Tranſitions from the* Order *or* Law *of Nature that obtains in one Species, to that of another. Thus it has been obſerved (though very rarely) that the* Liver *was ſituated in the left* Hypochondrium; *but as our Author remarks, it is not peculiar to it to lye on the Right-ſide in Animals; for in Fowls it lies equally on both, and in Fiſhes moſtly on the left.*

It is ſurpriſing that we have no tolerable Treatiſe on this Subject, which is in itſelf ſo entertaining and ſo conducive to promote Medicine. Thoſe, who have made Attempts this Way, have only collected and ranged in Order ſome particular Species, *ſuch as Birds or Fiſhes. They have likewiſe with great*

Labour given us Figures and Deſcriptions of them,—but all this is little elſe than mere Amuſement. 'Tis the Structure of their internal Organs we ſeek after, and the Manner how the different Functions of the animal Oeconomy are performed. Their Hiſtories of theſe are every way defective and erroneous. There are indeed noble Hints to be found in the Writings of ſome of our modern Anatomiſts, particularly thoſe of the immortal Dr. Harvey. *That great Man well underſtood the Importance of this Science to advance Medicine, and accordingly imployed the moſt of his Time in diſſecting Animals of different Tribes, and making Experiments on them: by which Means he made the greateſt Diſcovery that ever was in the Science, and laid the Foundation of the preſent Syſtem. He had certainly left us other Treatiſes on this Subject, had he not been interrupted by the Civil Wars. The Phyſicians who lived then, imitating his Example, made many new Experiments on the Bodies of Brutes, changing their Juices by transfuſing of* *of new Liquors, accurately marking the Effects*, &c. *that all this might be transferred to the human Body; and indeed, from the Application of theſe Reaſonings, to the Obſervations they made on morbid Bodies, the Science ſeemed faſt advancing to that phyſical Certainty, which can be attained from Experiment and Obſervation. But alas! this Spirit died with theſe great Men, and Theory and Calculation came in it's Place.* Mathematicks, *it was ſaid, could alone bring the Science to Certainty, and throw out Conjecture. The Quantity and Velocity of the Blood, the Force of the Heart, Diameters of the Veſſels*, &c. *were ſubjected to Meaſure and Number, and Diſeaſes next were to be accounted for all in a mathematical Manner.—This Method however did not ſucceed according to Wiſh; for firſt thoſe great Genius's diſagreed widely in their Calculations, and differed from one another; whence in place of certain Concluſions we had only Wranglings and Diſputes: not to mention, that ſome of* *them made ſuch Eſtimates, as muſt plainly appear ridiculous at firſt Sight*[a]. *This, you'll ſay, proves nothing, it was the Fault of the Artiſts, who aſſumed wrong Hypotheſes for their Calculations, or were not perhaps accurate in their Obſervations. True,—but whoſe Fault was it to adapt Figure and Number to a Subject which refuſes them, through it's numberleſs Deviations from fixed Laws and Conditions?—Is an animate Body a mere Bundle of hard conical elaſtic Tubes, and the Heart a Pump forcing the Liquors through? Are then all the Veſſels exact Cones, or have any two*

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[a] The ingenious Dr. *Pitcairn* was the chief Man in theſe Parts, who gave into this Way. He ſuppoſes the Force of Muſcles to be in a *compound Ratio* of their Length, Breadth and Depth; that is, as they are *homogeneous Solids* in the *Ratio* of their Weights. Whence knowing the Force of any one Muſcle, we can by the Rule of Proportion (from their Weights) determine *that* of another. This he applies to the Stomach, and by the Computation it's muſcular Force is equal at leaſt to 117088lb. Weight.——That Muſcles are in that Proportion, is a mere *Hypotheſis*, for which the Doctor does not offer the ſmalleſt Proof; and had he aſſigned five Ounces as the Weight of the Stomach, he had been nearer the Truth. This is one glaring Inſtance, how much *Theory* and *Whim* may prevail with the greateſt of Men over common *Senſe*.

Anatomiſts *agreed in their Meaſures of them? Do they not yield every Way? And are they not continually obſtructed in different Places? Are there not many different Attractions prevailing for the ſeveral Secretions, and many different Forces acting on the Veſſels at the ſame Time which can never be determined?* &c. *Theſe and ſuch like Conſiderations will ſoon convince us how little the Practice of Medicine is to be promoted by thoſe Speculations*[b]. *If theſe Gentlemen meant by mathematical Reaſoning phyſical Experiments, then no one ever doubted of this, no more than they do of the Uſe of Mathematicks in Natural Philoſophy itſelf. But as this ſeems not to be their Senſe of the Matter,*

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[b] The Authority of *Hippocrates* is often adduced in this Argument, for which they cite two Paſſages. In the one he recommends the Study of *Aſtronomy*, as neceſſary to a Phyſician, and in the other, that of *Arithmetic* and *Geometry*.——The firſt he did from his Belief in the Influence of the *Stars*, and the ſecond from his Veneration for the *Pythagoric Numbers*; in the Myſteries of which he founded his Theory of the *Criſes* in acute Diſeaſes: Both theſe Conſiderations then are foreign to the Purpoſe, nor is there in any of his genuine Writings the ſmalleſt Veſtige of this kind of Reaſoning. On the contrary *Celſus* ſays of him, *Primus ab ſtudio Sapientiae Medicinam ſeparavit.*

they ſhould point out a few Diſeaſes which this Science has explained, and wherein it has corrected the received Practice. — But I am quite got from the Subject to what is foreign. To return then, Comparative Anatomy *has hitherto been treated but by Pieces. Thus ſome writing on the human Eye, have examined the Eyes of other Animals ; and ſo with regard to the Heart,* &c. *Some have given us the Deſcription of one particular Animal, others of another. But no one Author, as I know of, has given us a Syſtem of this Science where we might have a ſummary View of the moſt material Differences in the Structure of Animals. There are indeed Compends of this Science if you will, which are eſteemed by many, and were wrote with the noble Deſign of illuſtrating the Wiſdom and Goodneſs of our Maker. But thoſe who compoſed them were not Anatomiſts themſelves, ſo could only collect from others, which they often do without any Judgment—for how voluminous ſoever their Works may be, yet if you'll ſtrip them*

them of their repeated Exclamations, Citations of Authors and Books, the many ſtrange and ſurprizing Stories, all told however by creditable Vouchers, you'll have little left behind beſides an indigeſted Chaos of Hiſtories and Deſcriptions, ſome true and many falſe. The Argument however was popular, and they could not fail of pleaſing.

The Author of theſe few Sheets is certainly a great Maſter of the Subject, and has here laid down an uſeful Plan, which will not be difficult for others to compleat. The Deſcriptions, 'tis eaſy to ſee, are all taken from the Life, and his Reaſoning plain and concluſive. Theſe are intermixed with many practical Obſervations in Medicine and Surgery, which muſt equally inſtruct and entertain the Reader.—You have now a few looſe Reflections on this Subject, wherein I have intirely confined myſelf to that Light, in which it is here treated. I ſhall only remark one Thing more, that the Author's Modeſty is at leaſt equal to his Capacity and Knowledge;

Knowledge; a rare Quality to be met with in an Anatomiſt! Read him on the Subject of the Human Allantois, *and obſerve his Concluſion of the Argument. You muſt then ſay, it had been happy for the Publick, if half ſo much Candour and Self-diffidence had prevailed in the Diſputes among the Learned. The World had been more inſtructed, and they more juſtly eſteemed.*

I am, Sir,

Your moſt humble Servant.

AN ESSAY ON Comparative Anatomy.

The INTRODUCTION.

The Uſes of Comparative Anatomy.

THE principal Advantages of Comparative Anatomy are the following: Firſt, It furniſhes us with a ſufficient Knowledge of the different Parts of Animals, to prevent our being impoſed upon by ſuch Authors who have delineated and deſcribed ſeveral Parts from Brutes as belonging to the human Body. Secondly, It helps us to underſtand ſeveral Paſſages in the ancient Writers in Medicine, who have taken many of their Deſcriptions from Brutes and reaſoned from them; their Reaſonings have often been miſapplied (and conſequently wrong explained) by the Moderns through a fooliſh Fondneſs to ſupport their own Inventions, or give an Air of Antiquity to a favourite Hypotheſis. The third and great Uſe we reap from this Science, is the Light it caſts on ſeveral Functions in the human Oeconomy about which there have been ſo many Diſputes among Anatomiſts: Theſe will be in a great Meaſure cleared up by exhibiting the Structure of the ſame Parts in different Animals, and comparing the ſeveral Organs imployed in performing the ſame Action, which in the human Body is brought about by one more complex.

How the Action of Muſcles is determined.

In this View 'tis altogether needleſs to inſiſt on thoſe Parts whoſe Uſe is eaſily underſtood when once their Structure is unravelled; thus for Inſtance, if we be acquainted with the Action of the Muſcles in general, it will not be difficult to determine the Uſe of any particular Muſcle, whoſe Origin and Inſertion is known, if we at the ſame Time conſider the various Connexions of the Bones to which it is fixed, and the different Degree of Mobility they have with Reſpect to each other: In the ſame Manner if we know the Uſe of the Nerves in general, we can eaſily aſſign the Uſe of thoſe Nerves which are diſtributed to any particular Part. There is then no Occaſion for a complete *Oſteology*, *Myology*, *&c.* of the ſeveral Animals we ſhall treat of, nor need we trouble ourſelves about the Structure of any of the Parts, unleſs when it ſerves to illuſtrate ſome of the fore-mentioned Purpoſes.

That the firſt Uſe we propoſed from examining the Structure of the Parts in Brutes is real and of Conſequence, is evident from looking into the Works of ſome of the earlieſt and greateſt Maſters of Anatomy, who for want of human Subjects have often borrowed their Deſcriptions from other Animals. The great *Veſalius*, although he juſtly reproves *Galen* for this Fault, is guilty of the ſame himſelf, as is plain from his Delineations of the Kidneys, *Uterus*, the Muſcles of the Eye and ſome other Parts. Nor is Antiquity only to be charged with this, ſince in *Willis's Anatomia Cerebri* (the Plates of which were reviſed by that accurate Anatomiſt Dr. *Lower*) there are ſeveral of the Pictures taken from different Brutes, eſpecially the Dog, beſides thoſe he owns to be ſuch.

We ſhall give ſeveral Examples of the ſecond Uſe in the Sequel of the Work.

The Variety and Uniformity obſervable in Nature.

The Animal Kingdom, as well as the Vegetable, contains the moſt ſurpriſing Variety, and the Deſcent in each is ſo gradual, that the little Tranſitions and Deviations are almoſt imperceptible. The Bat and Flying-Squirrel, though *Quadrupeds*, have Wings to buoy themſelves up in the Air. Some Birds inhabit the Waters, and there are Fiſhes that have Wings, and are not Strangers to the airy Regions; the Amphibious Animals blend the Terreſtrial and *Aquatic* together.

The animal and vegetable Kingdoms are likewiſe ſo nearly connected, that if you take the higheſt of the one, and the loweſt of the other, there will ſcarce be preſerved any Difference: For Inſtance, what Difference is there betwixt an Oiſter, one of the moſt inorganiſed of the animal Tribe and the ſenſitive Plant, the moſt exalted of the vegetable Kingdom? They both remain fixed to one Spot, where they receive their Nouriſhment, having no proper Motion of their own, ſave the ſhrinking from the Approach of external Injuries.

Thus we obſerve a ſurpriſing Chain in Nature.

As there is then ſuch a vaſt Variety, it is not only needleſs but impoſſible to conſider all of them particularly. We ſhall take only ſome of the moſt remarkable *Genera*, and hope from what will be ſaid of them any of the intermediate Degrees may be underſtood.

Diviſion of Animals into Quadrupeds, Volatiles, Fiſhes, and Inſects.

In treating of *Quadrupeds*, we ſhall divide them into the *Carnivorous*, *i. e.* thoſe that feed indifferently on animal and vegetable Subſtances, and *Granivorous*: As an Inſtance of theſe laſt we ſhall take the ruminant Kind. The Fowls we ſhall alſo divide into thoſe that feed on Grain, and thoſe that feed on Fleſh. The Diſtinction we ſhall make in treating of Fiſhes, ſhall be of thoſe that have Lungs, and thoſe that have them not. The firſt indeed are with Difficulty procured, and at the ſame Time differ very little from *Quadrupeds*.

As the Structure of Inſects is ſo very minute, and lends us but little Aſſiſtance for the Ends propoſed, we purpoſely omit them.

In inquiring into the Structure of different Animals, we ought to be previouſly acquainted with the form of their Body, manner of Life, kind of Food; or in ſhort, with their natural Hiſtory, which will lead us to account for the Reaſon of their different Structure, and thence explain the Actions of the human Body.

Of Quadrupeds *in general.*

ALL *Quadrupeds* have a Covering of Hair, Wool, *&c.* to defend them from the Injuries of the Weather, which varies in Thickneſs according to the Seaſon of the Year, and Difference of the Climate: Thus in *Ruſſia* and the Northern Countries, the Furs are very thick and warm, while the little *Spaniſh* Lap-dogs, and *Barbary* Cows, have little or no Hair at all.

Cuticula, Cutis, Panniculus Carnoſus.

The *Cutis* and *Cuticula* in *Quadrupeds* are diſpoſed much in the ſame Way as the human, only more elaſtic; immediately under this, there is a very thin cutaneous muſcular Subſtance called *Panniculus Carnoſus,* which is common to all *Quadrupeds,* the *Porcine* Kind excepted; this principally covers the Trunk, ſerving to ſhrivel the Skin, in order to drive off Inſects, their Tails and Heads not being ſufficient for this Purpoſe, while their

Extremities are employed in their Support and Progreſſion.

Whence the Notion of the Panniculus Carnoſus, &c.

It has probably been from obſerving ſome Muſcles of the human Body, ſuch as the *Platyſma Myoides*, *Cremaſter*, and *Frontales*, and the collapſed *Tunica Celluloſa* of emaciated Subjects, to reſemble this thin Muſcle, that ſome of the older Anatomiſts reckoned ſuch a *Panniculus* among the common *Teguments* of the human Body. This *Carolus Stephanus* has well obſerved.

Why moſt Quadrupeds want Clavicles.

Moſt part of *Quadrupeds* want *Clavicles*, whereby their anterior Extremities fall upon their Cheſt, ſo as to make their *Thorax* proportionally narrower than the Human. This ſmall Diſtance of their anterior Extremities is very neceſſary for their uniform Progreſſion: Apes indeed and Squirrels have *Clavicles* to allow them a more full Uſe of their Extremities in climbing, but when they ſit down on all-four they walk but indifferently.

The Anatomy of a Dog.

WE may firſt obſerve of this Animal, as indeed of moſt *Quadrupeds*, that it's Legs are much ſhorter in Proportion to it's Trunk than in Man, the Length of whoſe Steps depends entirely on the Length of his inferior Extremities; however to balance this the Trunk of the Animal is proportionally longer and ſmaller, his Spine more flexible, by which he is able at each Step to bring his poſterior Extremities nearer to his anterior. *Cutis.* His common *Teguments* are much a-kin to thoſe of other *Quadrupeds*, only they allow little or no Paſſage for Sweat, but when he is over-heated the ſuperfluous Matter finds an Exit by the Salivary Glands, for he lolls out his Tongue and ſlavers plentifully.

Abdomen, Muſculi Pyram. The pyramidal Muſcles are wanting, to ſupply which the *Rectus* is inſerted fleſhy into the *Os Pubis*.

Omentum.

The *Omentum* reaches down to the *Os Pubis*, which conſidering the Poſture of the Animal we will find to be a wiſe Proviſion, ſince it's Uſe is to ſeparate an oily Liquor for lubricating the Guts and facilitating their periſtaltick Motion; ſo in our erect Poſture the natural Gravity of the Oil will determine it downward, but in the horizontal Poſition of theſe Creatures, if all the *Inteſtines* were not covered, there would be no favourable Derivation of the Fluid to the Guts lying in the poſterior Part of the *Abdomen*, which is the higheſt; and beſides, had the *Omentum* reached much farther down in us, we had been in continual Hazard of an *Epiplocele*, which the Dog is not ſubject to as his *Viſcera* don't preſs ſo much on the Rings of the *Abdominal* Muſcles. The inferior and anterior *Lamella* of the *Omentum* is fixt to the Spleen, *Fundus* of the Stomach, *Pylorus*, Liver, *&c.* in the ſame Way as the human,

man, but the ſuperior having no *Colon* to paſs over, goes directly to the Backbone. This ſerves to explain the Formation of the ſmall *Omentum* in the human Body, which is nothing but the large *Omentum*, having loſt it's Fat, paſſing over the Stomach and *Colon*, where it reaſſumes it's *Pinguedo*, ſo proceeds and is firmly attached to the Liver, Spine, *&c.* The Striæ of Fat are pretty regularly diſpoſed through it, accompanying the Diſtribution of the Blood-Veſſels to guard them from the Preſſure of the Super-incumbent *Viſcera*.

Ventriculus. This Animal's Stomach, though pretty much reſembling the human in it's Shape, is ſomewhat differently ſituated. It lies more longitudinal, as indeed all the other *Viſcera* do to accommodate themſelves to the Shape of the Cavity in which they are contained, that is, it's inferior Orifice is much farther down with reſpect to the ſuperior than the human: By this Means the groſs Food has an eaſier Paſſage into the *Duodenum.* Again, the *Fundus* of the human Stomach, when diſtended, ſtands almoſt directly forwards, which is occaſioned by the little *Omentum* tying it ſo cloſe down to the Backbone, *&c.* at it's two Orifices; but it not being fixed in that manner in the Dog, the *Fundus* remains always poſterior: This alſo anſwers very well the Shape of the different Cavities, the Diſtance betwixt the *Cardia* and *Fundus* being greater than that betwixt the two Sides. It ſeems to be much larger in Proportion to the Bulk of the Animal than the human, that it might contain a greater Quantity of Food at once, which was very neceſſary, ſince this Animal cannot at any Time get it's Suſtenance as Men do. The *Turbillion* is not ſo large, nor is there any Coarction forming the *Antrum Williſii* as in the Stomach of Man. It is conſiderably thicker and more muſcular than ours for breaking the Coheſion of their Food, which they ſwallow without ſufficient chewing. Hence it is evident the Force of the Stomach is not ſo great as ſome would have it, nor it's Contraction ſo violent; otherwiſe that of Dogs would be undoubtedly wounded by the ſharp Bones, *&c.* they always take down; for the Contraction here is ſtill greater than in the human Stomach, which is much thinner. The *Rugæ* of the *Tunica Villoſa* are neither ſo large nor ſituated tranſverſely as in the human, but go from one Orifice to the other; the Reaſon of which Difference is, perhaps, that they might be in leſs Danger of being hurt by the hard Subſtances this Creature frequently feeds upon, and for the ſame Reaſon there is not the like Coarction at their *Pylorus*.

Inteſtines. The *Inteſtines* of this Animal are proportionally much ſhorter than ours, for the Food which theſe Creatures moſtly uſe, ſoon diſſolves and then putrifies; on which Account there was no Occaſion for a long Tract of *Inteſtines*, but on the contrary that it ſhould be quickly thrown out of the Body:

the ſame is to be obſerved of all the carnivorous Animals. The *muſcular Coat* of the *Inteſtines* is alſo ſtronger than the human, to protrude the hard Bones, leſt they ſhould ſtop ſomewhere in the Canal.

The *Valvulæ Conniventes* are leſs numerous, and in a longitudinal Direction.

Duodenum.

The *Duodenum* differs conſiderably in it's Situation from the human; for in Man it firſt mounts from the *Pylorus* upwards, backwards, and to the Right-ſide, then paſſes down by the Gall-bladder, and marching over the Right-kidney and ſuperior Part of the *Pſoas Muſcles*, makes a Curvature upwards, and paſſes over the Back-bone and *Vena Cava inferior*, to the left *Hypochondrium*, where it gets through the *Omentum*, *Meſentery* and *Meſocolon* to commence *Jejunum*, being firmly tied down all the Way, the *Biliary* and *Pancreatic Ducts* entering at it's moſt depending Part: whereas in

Jejunum.

in the Dog the *Duodenum* is fixed at the *Pylorus* to the concave Surface of the Liver, and hangs looſe and pendulous with the *Meſentery* backwards into the Cavity of the *Abdomen,* then turning up again is fixed to the Backbone, where it ends in the *Jejunum*; the Bile and *Pancreatic* Juice are poured into it at the moſt depending Part; therefore the ſame Intention ſeems to have been had in View in the Formation of this Part in both, *viz.* the giving the Chyle, after the Liquors of the Liver and *Pancreas* are poured into it, a diſadvantageous Courſe, that ſo it might be the more intimately blended with the Humours before it's Entry into the *Jejunum,* where the *Lacteals* are very numerous: And thus by reaſon of their different Poſture, the ſame Deſign (though by a very different Order of the Parts) is brought about in both.

Inteſtina Tenuia. The other ſmall Guts are much the ſame with ours, only ſhorter. The great Guts are alſo ſhorter and leſs capacious than in the human Body; and we take it for a general Rule, that all Animals that live on vegetable Food, have not only their ſmall Guts conſiderably longer, but alſo their great Guts more capacious than ſuch Creatures as feed on other Animals. Hence Man from this Form of his *Inteſtines* and that of the *Teeth*, ſeems to have been originally deſigned for feeding on Vegetables, and ſtill the moſt of his Food and all his Drink is of that Claſs.

The Reaſon of this Difference ſeems to be, that as animal Food is not only much more eaſily reduced into *Chyle*, but alſo more prone to Putrefaction, too long a *Remora* of the Juices might occaſion the worſt Conſequences. So it was neceſſary that their Receptacles ſhould not be too capacious, but on the contrary, being ſhort and narrow, might conduce to the ſeaſonable Diſcharge of their Contents. Whereas vegetable Food being more difficultly diſſolved and converted into an animal

Nature, there was a Neceſſity for ſuch Creatures as fed on it to be provided with a long internal Canal, that this Food in it's Paſſage might be conſiderably retarded, and have Time to change it's *Indoles* into one more agreeable to our Nature. Beſides which, there is another Advantage which accrues to Man in particular, from having his great Guts very capacious; for as he is a rational Being, and moſtly employed in the Functions of ſocial Life, it would have been very inconvenient as well as unbecoming for him to be too frequently employed in ſuch ignoble Exerciſes, ſo that having this large Reſervoir for his *Fæces Alvinæ*, he can retain them for a conſiderable Time without any Trouble.

Appendix Vermiformis.

The *Appendix Vermiformis* juſtly enough deſerves the Name of an *Inteſtinum Cecum* in this Subject, though in the human Body it does not, and it has probably been from the Largeneſs of this Part in other Animals, that the oldeſt Anatomiſts came to reckon that ſmall Apendicule in Man as one of the great Guts: On it's internal Surface we obſerve a great Number of mucous Glands.

Colon. The *Colon* has no longitudinal Ligaments, and conſequently this Gut is not purſed up into different Bags or Cells as the human, nor does this *Inteſtine* make any circular Turn round the *Abdomen*, but paſſes directly acroſs it to the Top of the *Os Sacrum*, where it gets the Name of *Rectum*.

Rectum. At the Extremity of the *Inteſtinum Rectum* or Verge of the *Anus*, there are found two Bags or Paunches which contain a moſt abominable fetid Mucus for which I know no Uſe, unleſs it ſerves to lubricate the ſtrained Extremity of the *Rectum*, and defend it againſt the Aſperity of the *Fæces*, or to ſeparate ſome Liquor that might otherwiſe prove hurtful to their Bodies. There is nothing analogous to thoſe Sacs in the human Subject, unleſs we reckon the mucilaginous Glands that are found moſt frequent and largeſt about the lower Part of the *Rectum.*

Meſentery. The *Meſentery* is conſiderably longer than in the human Body, for in Man had the *Meſentery* been very long, the Guts would have fallen down on the Stomach, *&c.* by Reaſon of his erect Poſition. The Fat is here diſpoſed in the ſame Way, and for the ſame Reaſon, as in the *Omentum.* The *Interſtices* betwixt the Fat are filled with a fine Membrane. Inſtead of a great Number of *Glandulæ Vagæ* to be found in the human *Meſentery,* there is only one large Gland to be obſerved in the Middle of the *Meſentery* of a Dog, which from it's imagined Reſemblance to the *Pancreas* and the Name of it's Diſcoverers, is called *Pancreas Aſellii.* The Reaſon why this in Man is as it were ſubdivided into many ſmaller ones, may poſſibly be, that as the Guts of a human Body are proportionally much longer than thoſe of this Creature, it would have been inconvenient to have gathered all the

Pancreas Aſellii.

the *Lactea primi generis* into one Place, whereas by collecting a few of theſe Veſſels into a neighbouring Gland the ſame Effect is procured much more eaſily.

Pancreas.

The *Pancreas* in Man lies croſs the *Abdomen*, tied down by the *Peritoneum*; but the Capacity of this Creature's *Abdomen* not allowing of that Situation, it is diſpoſed more longitudinally, being tied to the *Duodenum* which it accompanies for ſome Way. It's *Duct* enters the *Duodenum* about half an Inch below the others.

Spleen.

The Spleen of this Animal differs from ours very much, both in Figure and Situation. It is much more oblong and thin, and lies more according to the Length of the *Abdomen*, like the *Pancreas*. Though the Spleen of this Creature is not firmly tied to the *Diaphragm* (which was neceſſary in our erect Poſture to hinder it from falling downwards) yet by the Animal's prone Poſition, it's poſterior

Parts being rather higher than the anterior, it comes to be always contiguous to this Muſcle, and is as effectually ſubjected to an alternate Preſſure from it's Action as the human Spleen is.

Liver. The human Liver has no *Fiſſures* or Diviſions, unleſs you pleaſe to reckon that ſmall one betwixt the two *Pylæ*, where the large Veſſels enter: Whereas in a Dog and all other Creatures that have a large Flexion in their Spine, as Lions, Leopards, Cats, *&c.* the Liver and Lungs are divided into a great many Lobes by deep Sections, reaching the large Blood-Veſſels, which in great Motions of the Back-bone may eaſily ſhuffle over one another, and ſo are in much leſs Danger of being torn or bruiſed, than if they were formed of one entire Piece, as we really ſee it is in Horſes, Cows, and ſuch Creatures as have their Back-bone ſtiff, and immoveable. There is here no *Ligamentum Latum* connecting the Liver to the *Diaphragm*, which in our Situation was neceſſary to keep the *Viſcus* in it's Place; whereas in this Creature it naturally gravitates forwards, and by the horizontal Poſition of the Animal is in no Danger of preſſing againſt the *Vena Cava:* The preventing of which is one Uſe generally aſſigned to this *Ligament* in Man. Had the Liver of the Dog been thus connected to the *Diaphragm*, the Reſpiration muſt neceſſarily have ſuffered; for as we ſhall ſee afterwards, this Muſcle is here moveable at the Center, as well as at the Sides: But in Man the Liver is fixed to the *Diaphragm*, moſtly at it's tendinous Part; that is, where the *Pericardium* is fixed to it on the other Side, ſo that it's in no Danger of impeding the Reſpiration, being ſuſpended by the *Mediaſtinum* and Bones of the *Thorax*. In Conſequence of this *Viſcus* being divided into ſo many *Lobes*, it follows that the *Hepatic Ducts* cannot poſſibly join into one common Trunk till they are quite out of the Subſtance of the Liver.

We come next, after having examined the *Chylopoietic Viſcera*, to diſcourſe of thoſe Organs that ſerve for the Secretion and Excretion of Urine, and firſt of the Kidneys, which in this Animal are ſituated much in the ſame Way as in the human Subject, but have no Fat on their inferior Surface, where they face the *Abdomen*, and are of a more globular Form than the human. The Reaſon of theſe Differences will eaſily appear, if you compare their Situation and Poſture in this Animal with thoſe in a Man who walks erect. They are placed in this Subject in the inferior Part of the Body, ſo are not ſubject to the Preſſure of the *Viſcera*, which ſeems to be the principal Cauſe of the Fatneſs of thoſe Organs in us, and perhaps may likewiſe be the Cauſe of our being more ſubject to the Stone than other Animals. Hence there is no need of any cellular Subſtance to ward off this Preſſure where there would neceſſarily be Fat collected; but the ſuperior

Kidneys.

Part of their Kidneys is pretty well covered with Fat, leſt they ſhould ſuffer any Compreſſion from the Action of the Ribs and Spine.

Papillæ. In the *internal* Structure there is ſtill a more conſiderable Difference, for the *Papillæ* don't here ſend out ſingle the ſeveral *Tubuli Uriniferi*, but being all united they hang down in Form of a looſe pendulous Flap in the Middle of the *Pelvis*, and form a kind of *Septum Medium*, ſo that a Dog has a *Pelvis* formed within the Subſtance of the Kidney. The only thing that is properly analogous to a *Pelvis* here, is that Sac or Dilatation of *Pelvis.* the *Ureters* formed at the Union of the *Ductulæ uriniferæ*. The Reaſon of theſe Particularities may probably be, that the Liquors of this Animal, as of all thoſe of the carnivorous Kind, being much more acrid than thoſe that live on vegetable Food, it's Urine muſt incline much to an Alcaleſcency, as indeed the Smell and Taſte of that Liquor in Dogs, Cats, Leopards, &c. evidently ſhew, being fetid and pungent, and therefore not convenient to be long retained in the Body. For this End it was proper, that the ſecerning Organs ſhould have as little Impediment as poſſible by Preſſure, *&c.* in the performing their Functions; and for that Deſign, the Mechaniſm of their Kidneys ſeems to be excellently adapted: We have moſt elegant Pictures in *Euſtachius* of the Kidneys of Brutes delineated, as ſuch, with a View to ſhew *Veſalius*'s Error in painting and deſcribing them for the human.

Capſulæ Atrabilariæ. The *Glandulæ* or *Capſulæ Atrabilariæ* are thicker and rounder than the human, for the ſame Reaſon as the Kidneys.

Ureters. The *Ureters* are more muſcular than the human, becauſe of the favourable Paſſage the Urine has through them; they enter the *Bladder* near it's *Fundus.*

The

Veſica Urinaria.

The Bladder of Urine differs conſiderably from the human, and firſt in it's Form, which is pretty much pyramidal or pyriform; this Shape of the Dog's Bladder is likewiſe common to all *Quadrupeds,* except the Ape and thoſe of an erect Poſture. In Men it is by no Means pyriform, but has a large Sac at it's poſterior and inferior Part: This Form depends entirely on the Urine gravitating in our erect Poſture to it's Bottom, which it will endeavour to protrude, but as it cannot yield before, being contiguous to the *Os Pubis,* it will naturally ſtretch out where there is the leaſt Reſiſtance, that is, at the poſterior and lateral Parts; and were it not for this Sac we could not come at the Bladder to extract the Stone either by the leſſer or lateral Operation of *Lithotomy*. Moſt Anatomiſts have delineated this wrong, ſo much, that I know of none who have juſtly painted it, excepting Mr. *Cowper* in his *Myotomia,* and Mr. *Rully*. It has certainly been from obſerving it in Brutes, and young Children, that they have been led into this Miſtake. The ſame Cauſe, *viz.* the Gravity of the Urine makes the Bladder of a different Form in Brutes; in their horizontal Poſition the *Cervix*, from which the *Urethra* is continued, is higher than it's *Fundus*, the Urine muſt therefore diſtend and dilate the moſt depending Part by it's Weight.

Connection.

As to it's Connection, it is faſtened to the *Abdominal* Muſcles by a Proceſs of the *Peritoneum*, and that Membrane is extended quite over it; whereas in us it's ſuperior and poſterior Parts are only covered by it: Hence in Man alone the high Operation of *Lithotomy* can be performed without Hazard of opening the Cavity of the *Abdomen*. Had the *Peritoneum* been ſpread over the Bladder in it's whole Extent, the Weight of the *Viſcera* in our erect Poſture would have ſo bore upon it, that they would not have allowed any conſiderable Quantity of Urine to be collected there; but we muſt have been

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been obliged to diſcharge it's Contents too frequently to be conſiſtent with the Functions of a ſocial Life. Whereas by Means of the *Peritoneum* the Urine is now collected in ſufficient Quantity, the *Viſcera* not gravitating this Way.

You may take it for a general Rule, that thoſe Creatures that feed upon animal Food have their Bladder more muſcular and conſiderably ſtronger, and leſs capacious than thoſe that live on Vegetables, ſuch as Horſes, Cows, Swine, *&c.* whoſe Bladder of Urine is perfectly membranous, and very large. This is wiſely adapted to the Nature of their Food, for in theſe firſt, as all their Juices are more acrid, ſo in a particular manner their Urine becomes exalted, which as it's *Remora* might be of very ill Conſequence, muſt neceſſarily be quickly expelled. This is chiefly effected by it's ſtimulating this *Viſcus* more ſtrongly to contract, and ſo diſcharge it's Contents. That a *Stimulus* is one of the principal Cauſes of

A Stimulus proved to be a principal Cauſe of the Evacuation of the Bladder.

of the Excretion of Urine, we learn from the common ſaline diuretic Medicines that are given, which are diſſolved into the *Serum* of the Blood, and carried down by the Kidneys to the Bladder: The ſame appears likewiſe from the Application of *Cantharides*, or without any of theſe, when the Parts are made more ſenſible, as in an Excoriation of the Bladder, there is a frequent Deſire to make Water. Accordingly we find theſe Animals evacuate their Urine much more frequently than Man, or any other Creature that lives on vegetable Food. And if theſe Creatures, whoſe Fluids have already a Tendency to Putrefaction, are expoſed to Heat or Hunger, the Liquids muſt for a conſiderable Time undergo the Actions of the containing Veſſels, and frequently perform the Courſe of the Circulation without any new Supplies of Food; by which the Fluids becoming more and more acrid, the Creature is apt to fall into feveriſh and putrid Diſeaſes; and in Fact we find that theſe Cauſes are ſufficient

Cauſes aſſigned for the Rabies Canina, &c.

ficient to produce that fatal and melancholy Diſtemper the *Rabies Canina, Vulpina, &c.* in theſe Animals; whereas thoſe that feed on vegetable Food ſeldom or never contract theſe Diſeaſes but by Infection.

Vaſa Spermatica.

The *Spermatic* Veſſels are much the ſame Way diſpoſed as in us; they are contained within the Cavity of the *Abdomen*, as the Guts are within the *Peritoneum*, which is ſpread over them, and from which they have a Membrane like a *Meſentery*, ſo hang looſe and pendulous in the *Abdomen:* whereas in us they are contained in the cellular Part of the *Peritoneum*, which is tenſely ſtretched over them. At their Paſſage out of the lower Belly, there appears a plain Perforation or Holes, and from obſerving this in *Quadrupeds* has ariſen the falſe Notion of *Hernia* or Rupture among Authors. This Opening is of no Diſadvantage to them, but evidently would have been to us, for from the Weight of our *Viſcera* and our continually gravitating upon

Whence the falſe Notion of Hernia or Rupture.

upon theſe Holes, we muſt have perpetually laboured under *Enteroceles*; this they are in no Hazard of, ſince in them this Paſſage is at the higheſt Part of their Belly, and in their horizontal Poſture, the *Viſcera* cannot bear upon it: And to prevent even the ſmalleſt Hazard, there is a looſe pendulous Semilunar Flap of Fat which ſerves two Uſes, as it both hinders the *Inteſtines* from getting into the Paſſage, and alſo the Courſe of the Fluids from being ſtopped in the Veſſels, which is ſecured in us by the cellular Subſtance and tenſe *Peritoneum*.

The *Septum Medium*, or Conjunction of the two *Tunics*, is the ſame as in Men. There is next a Paſſage quite down into the Cavity, where the *Teſticles* lie. Had the ſame Structure obtained in Man, by the conſtant drilling down of the Liquor which is ſecerned for the lubricating of the Guts, we ſhould always have laboured under an *Hydrocele*; but their Poſture ſecures them from any Hazard of this kind;

indeed your very fat Lap-dogs, who conſequently have an overgrown *Omentum*, are ſometimes troubled with an *Epiplocele*.

Scrotum.

The *Scrotum* is ſhorter and not ſo pendulous as the human, this it has in common with all the Dog Kind that want the *Veſiculæ Seminales*, who have it pretty cloſe tucked up, that the Seed at each Copulation might the ſooner be brought from the *Teſtes*, thus in ſome Meaſure ſupplying the Place of the *Veſiculæ Seminales*; for the Courſe of the Seed through the *Vaſa Deferentia* is thus ſhortened by placing the ſecerning Veſſels nearer the excretory Organs. This at the ſame Time explains the Reaſon why this Creature is ſo tedious in Copulation.

The Veſiculæ Seminales, how ſupplied.

Teſtes.

The Structure of the *Teſticles* is much the ſame with the human; as are likewiſe the *Corpus Pyramidale Varicoſum* or *Pampiniforme*, and the *Epididymis* or Excretory Veſſel of the *Teſticle*; the *Vaſa Deferentia* enter the *Abdomen* where the Blood Veſſels come out, and paſſing along the upper Part of the Bladder, are inſerted a little below the bulbous Part of the *Urethra.*

Penis. The *Præputium* has two Muſcles fixed to it; one that ariſes from the *Sphincter Ani*, and is inſerted all along the *Penis*, and this is called *Retractor Præputii*, but the other, whoſe Office is directly contrary to this, is cutaneous, and ſeems to take it's Origin from the Muſcles of the *Abdomen*, or rather to be a Production of their *Tunica Carnoſa*. The *Corpora Cavernoſa* riſe much in the ſame way as the human; but theſe ſoon terminate, and the reſt is ſupplied by a triangular Bone, in the inferior Part of which there is a Groove excavated for lodging the *Urethra.* There are upon the *Penis* two protuberant bulbous fleſhy Subſtances, at the back of which are two Veins, which by the *Erectores Penis* are compreſſed in the Time of Coition, and the Circulation being ſtopt, the Blood diſtends the large *cavernous* Bodies:

After the *Penis* is thus ſwelled, the *Vagina*, by it's Contraction, gripes it closely, and ſo the Male is kept in Action ſome Time contrary to his Will; till Time be given for bringing a Quantity of Seed ſufficient to impregnate the Female; and thus by that *Orgaſmus Veneris* of the female Organs, the want of the *Veſiculæ Seminales* are in ſome Meaſure ſupplied. But as it would be a very uneaſy Poſture for the Dog to ſupport himſelf ſolely upon his hinder Feet, and for the Bitch to ſupport the Weight of the Dog for ſo long a Time; therefore as ſoon as the bulbous Bodies are ſufficiently filled, he gets off and turns averſe to her; had then the *Penis* been pliable as in other Animals, the *Urethra* muſt of Neceſſity have been compreſſed by this twiſting, and conſequently the Courſe of the Seed intercepted; but this is wiſely provided againſt by the *Urethra*'s being formed in the Hollow of the Bone. After the Emiſſion of the Seed, the Parts turn flaccid, the Circulation is reſtored, and the bul-

Coitus.

bous Parts can be eaſily extended.

Proſtrata. The *Proſtrata* ſeems here divided into two, which are proportionably larger than the human, and afford a greater Quantity of that Liquid.

Uterus. The *Uterus* of *Multifarious* Animals is little elſe but a Continuation of their *Vagina*, only ſeparated from it by a ſmall Ring or *Valve*. From the *Uterus* two long Canals mount upon the Loins, in which the *Fœtus's* are lodged; theſe are divided into different *Sacs*, which are ſtrongly conſtricted betwixt each *Fœtus*, yet theſe Coarctions give Way in the Time of Birth. From theſe go out the *Tubæ Fallopianæ*, ſo that the *Ovaria* come to lodge pretty near the Kidneys.

We ought next to examine the Structure of the *Thorax* and it's Contents; but firſt it may not be amiſs to *Diaphragm.* remark of the *Diaphragm* in it's natural Situation, that it is in general more looſe and free than the human, which is owing to it's Connection with the neighbouring Parts in a different Manner from ours; the human *Diaphragm* is connected to the *Pericardium*, which again by the Intervention of the *Mediaſtinum* is tied to the *Sternum*, *Spine*, &c. but here there is ſome Diſtance between the *Diaphragm* and *Pericardium*. We obſerve further that it's middle Part is much more moveable, and the tendinous Parts not ſo large. And indeed it was neceſſary their *Diaphragm* ſhould be ſomewhat looſe, they making more uſe of it in difficult Reſpiration than Man. This we may obſerve by the ſtrong heaving of the Flanks of an Horſe or Dog when out of Breath; which correſponds to the riſing of the Ribs in us.

The Diſpoſition and Situation of the *Mammæ* vary as they bear one or more young. Thoſe of the uniparous Kind have them placed between the poſterior Extremities, which in them is the higheſt Part of their Bodies, whereby their Young get at them without the *Thorax.* **Mammæ.**

Inconvenience of kneeling; nevertheleſs, when the Creatures are of no great Size, and their Breaſt large, as in Sheep, the young ones are to take this Poſture. In multifarious Animals they muſt have a great Number of Nipples, that their ſeveral young ones may have Room at the ſame Time, and theſe diſpoſed over both *Thorax* and *Abdomen*; and the Creatures generally lye down when the Young are to be ſuckled, that they may give them the moſt favourable Situation. From this it does not appear to be from any particular Fitneſs of the Veſſels at certain Places, for giving a proper Nouriſhment to the Child, that the Breaſts are ſo placed in Women, as we find them, but really from that Situation being the moſt convenient, both for Mother and Infant.

Sternum. *Coſtæ.* The *Sternum* is very narrow, and conſiſts of a great Number of ſmall Bones, moveable every Way, which always happens in Creatures that have a great Mobility in their *Spine*. The

Ribs are ſtreighter and by no Means ſo convex as the human, whereby in Reſpiration the Motion forward will very little enlarge their *Thorax*, which is compenſated by the greater Mobility of their *Diaphragm*: ſo our *Thorax* is principally enlarged according to it's Breadth and Depth, and theirs according to it's Length. The want of *Clavicles*, and the conſequent falling in of the anterior Extremities upon the Cheſt, may contribute ſomewhat to the Streightneſs of the Ribs.

Mediaſtinum.

The *Mediaſtinum* in this Creature is pretty broad, whereas the human being ſo narrow has occaſioned a Diſpute whether there be ſuch a Thing or not. The *Pericardium* is not here contiguous to the *Diaphragm*, but there is an Inch of Diſtance betwixt them, in which Place the ſmall Lobe of the Lungs lodges, and by this Means the Liver, *&c.* of this Animal, though continually preſſing upon the *Diaphragm*, yet cannot diſturb the Heart's Motion.

Cor. The Heart is ſituated with it's Point almoſt directly downwards, according to the Creature's Poſture, and is but very little inclined to the Left-ſide. It's Point is much ſharper, and it's Shape more Conoidal than the human. Here the Names of right and left *Ventricles* are proper enough, though not ſo in the human, which ought rather to be called anterior and poſterior, or ſuperior and inferior. **Vena Cava.** The Animal has the *Vena Cava* of a conſiderable Length within the *Thorax*, having near the whole Length of the Heart to run over ere it gets at the *Sinus Lowerianus Dexter.* In Men, as ſoon as it pierces the *Diaphragm*, ſo ſoon it enters the *Pericardium*, which is firmly attached to it, and immediately gets into the *Sinus Lowerianus*; which *Sinus* in the human Subject, by the oblique Situation of the Heart, is almoſt contiguous to the *Diaphragm*, and by this we diſcover that ſeveral Authors have taken their Delineations of the human Heart from Brutes, which is eaſily detected by the Shape and Situation of the Heart, and long *Vena Cava* within the *Thorax*. This was one of the Faults of the curious Wax-Works, that were ſhewn at *London* and *Paris*, which was plainly taken from a Cow.

This Situation of the Heart of the Creature agrees beſt with the Shape of it's *Thorax*, which is lower than the *Abdomen*.

Aorta aſcendens improperly ſo called.

The Egreſs of the large Blood-Veſſels from the Heart is ſomewhat different from the human, for here the left *Subclavian* comes off firſt, and then a large Trunk runs ſome way upwards before it gives off the left *Carotid*, and ſplits into the *Carotid* and *Subclavian* of the Right-ſide: So that neither here, properly ſpeaking, is there an *Aorta aſcendens*, more than in the human, but this Name has probably been impoſed upon it from obſerving this in a Cow, where indeed there is an aſcending and deſcending *Aorta*.

From this Speciality of the Diſtribution of the Veſſels of the Right-ſide, which happens, though not in ſo great a Degree, in the human Subject, we may perhaps in ſome Meaſure account for the general greater Strength, Readineſs or Faculty of Motion which is obſervable in the Right-Arm. I believe upon meaſuring the Sides of the Veſſels, the Surface of the united Trunk of the right *Subclavian* and *Carotid* is leſs than that of the left *Subclavian* and *Carotid*, as they are ſeparated; if ſo, the Reſiſtance to the Blood muſt be leſs in that common Trunk, than in the left *Subclavian* and *Carotid*; but if the Reſiſtance be ſmaller, the abſolute Force with which the Blood is ſent from the Heart being equal, there muſt neceſſarily be a greater Quantity of Blood ſent through them in a given Time: And as the Strength of the Muſcles is, *cæteris paribus*, as the Quantity of Blood ſent into them in a given Time, thoſe of the Right-Arm will be ſtronger than thoſe of

A Mechanical Account of the ſuperior Strength of the Right-Arm, Leg, &c.

of the Left. Now Children being conſcious of this ſuperior Strength, uſe the Right upon all Occaſions, and thus from Uſe comes that great Difference which is ſo obſervable. That this is a ſufficient Cauſe ſeems evident from Fact; for what a Difference is there betwixt the Right and the Left-Arm of one, who has played much at Tennis? View but the Arms of a Blackſmith, and Legs of a Footman, and you'll ſoon be convinced of this Effect ariſing from uſing them. But if by any Accident the Right-Arm is kept from Action for ſome Time, the other from being uſed gets the better, and thoſe People are Left-handed: For it is not to be imagined that the ſmall Odds in the original Formation of the Veſſels ſhould be ſufficient to reſiſt the Effect of Uſe and Habit, (Inſtances of the contrary occur every Day;) 'tis enough for our preſent Argument, that where no Means are uſed to oppoſe it, the Odds are ſufficient to determine the Choice in favour of the Right. Now becauſe it's natural to begin with the

Leg correſponding to the Hand we have moſt Power of; this is what gives alſo a Superiority to the Right-Leg.

This Difference is not peculiar to Man, but is ſtill more obſervable in thoſe Creatures, in whom the ſame Mechaniſm does obtain in a greater Degree. Do but obſerve a Dog at a Trot, how he bears forwards with his Right-ſide, or look at him when a ſcraping up any Thing, and you will preſently ſee that he uſes his Right much oftner than he does his Left-Foot. Something analogous to this may be obſerved in Horſes.

Thymus.

Glandula Thyroidea.

The *Thymus* of this Creature is proportionably much larger than ours, whereas the *Glandula Thyroidea* is much leſs, and it's generally remarked that theſe two Glands do thus always ſupply the Place of each other: That is, in ſuch Animals as have a large *Thymus*; the *Glandula Thyroidea* is ſmaller, and *vice verſa*. Hence we are naturally led to aſcribe the ſame Uſe to both, *viz.* the Separation of a thin *Lymph* for diluting the *Chyle* in the *Thoracic Duct*, before it be poured into the Blood; then if we conſider the different Formation of the *Thorax* in both, we ſhall readily account for the Variety in the Bulk of theſe two Glands. Reſpiration being chiefly performed in Man by the widening of the Cheſt, the Lungs at every Inſpiration muſt preſs upon the *Thymus*, and conſequently diminiſh it; but the *Diaphragm* yielding more in the Dog's Inſpiration, this Gland is not ſo much preſſed by the Lungs and ſo will be larger, and hence the *Glandula Thyroidea* will be proportionably leſs: Again, from the Poſture of this Creature we ſhall ſee that it was much more convenient for a Dog to have the moſt Part of the diluting *Lymph* ſupplied by the *Thymus*, ſince the Neck being frequently in a deſcending Poſture, the *Lymph* of the *Thyroid* Gland would have a very diſadvantageous Courſe to get to the *Thoracic Duct*: whereas in the human Body, the *Thymus* is really below the *Lacteal* Canal, where it makes it's Curvature, before it opens into the *Subclavian*, and conſequently there is a Neceſſity of a conſiderable Share of the diluting Liquor being furniſhed by the *Thyroid* Gland, which is ſituated much higher, ſo that it's *Lymph* has the Advantage of a perpendicular Deſcent.

Ductus Thoracicus.

We may here obſerve that the *Thoracic Duct* in a Dog has no Curvature before it enters the *Subclavian* Vein. The horizontal Poſition of this Animal allowing a favourable enough Courſe to the *Chyle*, ſo as not to need that Turn to force it's Paſſage into the Blood. The Lungs of this Creature are divided into more numerous Lobes and deeper than they are in Man, for the ſame Reaſon as the Liver. The Left-ſide of the *Thorax* in this Animal bears a greater Proportion to the Right than in Man, the one being nearly as three to two, the other as four to three.

We look on it as a general Rule, *Neck.* that all *Quadrupeds*, as having Occaſion to gather their Food from the Ground, are provided with longer Necks than Man; but as a long Neck not only gives the Advantage of too long a *Lever* to the Weight of the Head, but alſo when the Animal is gathering his Food, makes the Brain in Danger of being oppreſſed with too great a Quantity of Blood, by the Liquor in theſe Arteries having the Advantage of a Deſcent, while that in the Veins muſt remount a conſiderable Way contrary to it's own Gravity, it was therefore neceſſary that a Part of the Length of the Neck ſhould be ſupplied by the Length of the Jaws. *Jaws.* Thus we ſee Horſes, Cows, *&c.* who have no Occaſion for opening their Mouths very wide, yet have long Jaws. Bull Dogs indeed, and ſuch Animals as have Occaſion for very ſtrong Jaws, muſt of Neceſſity have them ſhort; becauſe the longer they are, the Reſiſtance to be overcome acts with a longer *Lever*. Another Exception to this general Rule, is, ſuch Animals as are furniſhed with ſomething analogous to Hands to convey their Food to their Mouths, as Cats, Apes, *&c.* *Teeth.* The *Teeth* of this Creature plainly ſhew it to be of the *Carnivorous* Kind, for there are none of them made for grinding their Food, but only for tearing and dividing it. Even it's poſterior *Teeth* are not formed with rough broad Surfaces as ours are; but are made conſiderably ſharper, and preſs over one another when the Mouth is ſhut; that ſo they may take the firmer hold of whatever comes betwixt them.

Tongue. The Tongue in Conſequence of the Length of the Jaws, is much longer than ours; and as this Creature feeds with his Head in a depending Poſture, the *Bolus* would always be in Danger of falling out of the Mouth, were it not for ſeveral *Prominences* placed moſtly at the Root of the Tongue, and crooked Backwards in ſuch a Manner, as to allow any Thing to preſs eaſily down to the Jaws; but to hinder it's Return. In ſome Animals who feed on living Creatures, theſe under Hooks are ſtill more conſpicuous, as in ſeveral large Fiſhes, where they are almoſt as large as their *Teeth* in the Forepart of their Mouth, and near as firm and ſtrong.

Amygdalæ.

When we open the Mouth, we ſee the *Amygdals* very prominent in the poſterior Part of it, ſo that it would appear at firſt View, that theſe were inconveniently placed, as being continually expoſed to Injuries from the hard Subſtances this Creature ſwallows; but upon a more narrow Scrutiny we find this provided for by two *Membranous Capſulæ*, into which the *Amygdals*, when preſſed, can eſcape and remove themſelves from ſuch Injuries.

Velum Pendulum Palati.

The *Velum Pendulum Palati*, is in this Creature conſiderably longer than in Man, to prevent the Food from getting into his Noſe; which would happen more frequently in this

Animal than in Man, becauſe of it's Situation while feeding.

Glottis. Epiglottis.

In this Subject there is no *Uvula*, but then the *Epiglottis*, when preſt down, covers the whole *Rima* entirely and naturally continues ſo; there is therefore a *Ligament* or rather Muſcle that comes from the *Os Hyoides* and Root of the Tongue that is inſerted into that Part of the *Epiglottis*, where it is articulated with the *Cricoid Cartilage* which ſerves to raiſe it from the *Rima*, though not ſo ſtrongly but that it may with a ſmall Force be clapt down again. If then in all ſuch Animals as have no *Uvula*, the *Epiglottis* is ſo ordered as to be capable of covering the *Rima* entirely, and if in Man the *Epiglottis* cannot be ſo preſt backwards and downwards, as to ſhut up the *Glottis* perfectly, but leaves a Space that can be exactly filled up by the *Uvula*, we may very reaſonably conclude that the Uſe of this Part is to ſupply this Deficiency in the *Epiglottis*.

The Uſe of the Uvula in Man.

In the upper Part of the *Pharynx*, behind the *Cricoid Cartilage*, there's a pretty large Gland to be found, which ſerves not only for the Separation of a *Mucous* Liquor, to lubricate the *Bolus* as it paſſes this Way, but alſo ſupplies the Place of a *Valve*, to hinder the Food from regurgitating into the Mouth, which it would be apt to do by reaſon of the deſcending Situation of the Creature's Head.

Oeſophagus. The *Oeſophagus* is formed pretty much in the ſame Way as the human; Authors indeed generally alledge, that *Quadrupeds* have their Gullet compoſed of a double Row of *Spiral Fibres* decuſſing one another, but this is proper to ruminating Animals, who have Occaſion for ſuch a Decuſſation of *Fibres*. The Action of theſe you may eaſily obſerve in a Cow chewing her Cud.

Organ of Smell. The Noſe is generally longer than in Man, and it's external Paſſage much narrower. The Internal Structure is alſo better adapted for an acute Smelling, having a larger convoluted Surface on which the *Membrana Scheideriana* is ſpread, and this is to be obſerved in moſt *Quadrupeds*, who have the *Oſſa Spongioſa* commonly large, and theſe too divided into a great Number of exceſſively fine thin *Lamellæ*. The Elephant, which has a Head pretty large in Proportion to it's Body, has the greateſt Part of it taken up with the Cavity of the Noſe and *frontal Sinuſſes*, which laſt extend almoſt over their whole Head, and leaves but a ſmall Cavity for their Brains. A very nice Senſe of Smelling was not ſo abſolutely neceſſary for Man, who has Judgment and Experience to direct him in the Choice of his Food; whereas Brutes, who have only their Senſes, muſt have theſe of Neceſſity acute, ſome having one Senſe in greater Perfection than others, according to their different Way of Life. We not only conclude *a priori* from the large expanded *Membrana Scheideriana* that their Senſe of Smelling is very acute, but we find it ſo by Cows, and Horſes, diſtinguiſhing ſo readily betwixt noxious and wholeſom Herbs, which they do principally by this Senſe.

Auris. The external Ear in different *Quadrupeds* is differently framed, but always calculated to the Creature's Manner of Life: In Shape it commonly reſembles the oblique Section of a *Cone* from near the *Apex* to the Baſis. Hares and ſuch other Animals as are daily expoſed to Inſults from Beaſts of Prey, have large Ears directed backwards, their Eyes warning them of any Danger before; rapacious Animals, on the other Hand, have their Ears placed directly forwards, as we ſee in the Lion, Cat, *&c.* The ſlow Hounds and other Animals that are deſigned to hear moſt diſtinctly the Sounds coming from below, have their Ears hanging downwards. Man again, who muſt equally hear Sounds coming from all Quarters, but eſpecially ſuch as are ſent from about his own Height, has his external Ear placed in a *Vertical* Manner, ſomewhat turned forward. In ſhort, wherever we ſee a Speciality in the Make of this Organ in any Creature, we ſhall with very little Reflection diſcover this Form to be more convenient for that Creature than another. There are ſome Differences to be obſerved in the Structure of the internal Ear, in different Animals; but we know ſo very little of the Uſe of the particular Parts of that Organ in the human Subject, that it's altogether impoſſible to aſſign Reaſons for theſe Variations in other Creatures.

Membrana Nictitans.

All *Quadrupeds* have at the internal *Canthus* of the Eye, a ſtrong firm *Membrane* with a *Cartilaginous* Edge, which may be made to cover ſome Part of their Eye, and this is greater or leſs in different Animals, as their Eyes are more or leſs expoſed to Dangers in ſearching after their Food: this *Membrana Nictitans*, as it is called, is not very large in this Animal; Cows, and Horſes have it ſo large as to cover one Half of the Eye like a Curtain, and at the ſame Time is tranſparent enough to allow Abundance of the Rays of Light to paſs through it; Fiſhes have a *Cuticle* always over their Eyes, as they are ever in Danger in that inconſtant Element. In this then we may alſo obſerve a ſort of Gradation.

Muſculus Suſpenſorius.

All *Quadrupeds* have a ſeventh Muſcle belonging to the Eye, called *Suſpenſorius*. It ſurrounds almoſt the whole *Optick Nerve*, and is fixed into the *Sclerotic* Coat as the others are; it's Uſe is to ſuſtain the Weight of the Globle of the Eye, and prevent the *Optick Nerve* being too much ſtretched, without obliging the four ſtraight Muſcles to be in a continual Contraction, which would be inconvenient. At the ſame Time this Muſcle may be brought to aſſiſt any of the other four, by cauſing one particular Portion of it to act at a Time.

Pupilla. The next Thing to be remarked, is the Figure of the Pupil, which is different in different Animals, but always exactly accommodated to the Creature's Way of Life. Man has it circular for obvious Reaſons; an Ox has it tranſverſe, to take in a larger View of his Food; Cats again have theirs ſomewhat perpendicular, (but can alter it pretty much) for a ſimilar Reaſon, and ſo of the reſt: The Pupil of different Animals varies in Wideneſs according as the internal Organs of Viſion are more or leſs acute; thus Cats and Owls who ſeek their Prey in the Night, or in dark Places (and conſequently muſt have their Eyes ſo formed as that a few Rays of Light may make a lively Impreſſion on the *Retina)* have their Pupils in Day-time contracted into a very narrow Space, as a great Number of Rays would oppreſs their nice Organs, while in the Night they dilate conſiderably. In the ſame Way when the *Retina* is inflamed, a great Number of

Rays of Light would occaſion a painful Senſation, therefore the Pupil is contracted; on the contrary in dying People, or in a beginning *Amauroſis* it is greatly dilated, as the Eyes on ſuch Occaſions are very difficultly affected, and as it were inſenſible.

Tapetum.

The poſterior Part of the *Choroid* Coat, which is called *Tapetum*, is of different Colours in different Creatures. Or Oxen feeding moſtly on Graſs have this *Membrane* of a green Colour, that it may reflect upon the *Retina* all the Rays of Light which come from Objects of that Colour, while other Rays are obſcured: Thus the Animal ſees it's Food better than other Objects. Cats and Owls have their *Tapetum* of a whitiſh Colour, and for the ſame Reaſons have the Pupil very dilatable, and their Organs of Viſion acute; and we ſhall find that all Animals ſee more or leſs diſtinctly in the Dark, according as their *Tapetum* approaches nearer to a white or black Colour. Thus Dogs who have it of a greyiſh

Colour diſtinguiſh Objects better in the Night than Man, whoſe *Tapetum* is dark brown, and who I believe ſees worſt in the Dark of any Creature: it being originally deſigned that he ſhould reſt from all Kinds of Employments in the Night-time. The Difference then of the Colour of the *Tapetum*, as indeed the Fabrick of any other Part in different Creatures, always depends on ſome particular Advantage accruing to the Animal in it's peculiar Manner of Life from this Singularity.

Cerebrum. We ſhall now proceed to the Brain, which we remark in the firſt Place is proportionally much ſmaller in all *Quadrupeds* than the human. The Reaſon of which may be, that as thoſe Creatures for the moſt Part ſeek their Food with their Heads in a depending Poſture, this Situation would make it very inconvenient for the Brain itſelf to ſend it's Animal Spirits (or it's Influence and Energy, let that be what it will) through the Nerves, ſo that it was neceſſary they ſhould be ſupplied from ſomewhere elſe, and conſequently there was no Reaſon for the Brain itſelf being of a great Bulk. As a Confirmation of this Theory, we find that the *Intercoſtal* and eight Pair of Nerves, which ſerve the vital Organs in the human Body, take their Origin from the *Encephalon*, which in *Quadrupeds* come moſtly from the *Theca Vertebrarum.* Again there was no ſuch Occaſion for ſo great a Quantity of Brains in thoſe Animals as in Man; ſeeing in them all it's Energy is employed in their Progreſſion, while Man has a great Waſte of Spirits in the Exerciſe of his Reaſon and Intellectual Faculties. And beſides all this, a great bulky Brain would be inconvenient to theſe Creatures, in ſo far as it would add conſiderably to the Weight of the Head, which having the Advantage of a long *Lever* to act with, would require a much greater Force to ſupport it, than now it does; for the Heads of the greateſt Parts of *Quadrupeds* are not near ſo heavy as they would at Sight ſeem to be, from the *Sinus Frontales* being produced a great Way upwards to enlarge the Organs of Smelling.

The Pits in the anterior Part of their Skulls are much more conſpicuous than in the human *Cranium*, which may be occaſioned by the depending Poſture of theſe Creatures Heads, while they gather their Food: The Brain at this time gravitating much on the Bones while they are as yet ſoft, will gradually make Impreſſions upon them at theſe Places where it riſes into Eminencies. This is prevented in Man moſtly by his erect Poſture.

The *Falx* is not near ſo large in *Quadrupeds* as in Man, as they have little Occaſion to be on either Side, and the two *Hemiſpheres* of the Brain are in a great Meaſure hindred from juſtling againſt one another in violent Motions, by the Brain's inſinuating itſelf into the above-mentioned Pits.

The ſecond Proceſs of the *Dura Mater*, or *Tentorium Cerebello Superexpanſum* is conſiderably thicker and ſtronger in moſt *Quadrupeds* than in Man, eſpecially in ſuch of them as are very ſwift of Foot, as Hares and Rabbits, and that moſt when they are old. This Membrane is generally oſſified, that it may the more effectually keep off the Weight of the ſuperincumbent Brain from the *Cerebellum* in their rapid Motions, which otherwiſe would be of bad Conſequence.

Proceſſus Mamillaris.

The olfactory Nerves are very large, and juſtly deſerve the Name of *Proceſſus Mamillaris*. They are hollow, and conſiſt of a *medullary* and *cineritious* Subſtance, and at firſt Sight appear to be anterior Ventricles of the Brain produced; but in Man they are ſmall, and without any diſcernable Cavity. The Reaſon of this is pretty evident, if we conſider how this Animal's Head is ſituated; for the *Lymph* continually gravitating upon the inferior Part of the *Ventricles* may thus elongate and produce them: But from this very inferior Part the *Olfactory Nerves* riſe, and are ſent immediately through the *Os Ethmoides* into the Noſe. Hence the Ancients thinking they were continued hollow into the Noſe, believed they were the *Emunctories* of the Brain; in the Brain of Sheep, which by its firm Texture is the beſt Subject of any for ſearching into the Structure of this Part, we evidently ſee, that the Name of the *Sigmoid* Cavities was very properly applied by the Ancients to the lateral Ventricles of the Brain, which are really of a greater Extent than they are ordinarily painted by the Anatomiſts, reaching farther backwards and forwards again under the Subſtance of the Brain.

Nates. *Teſtes.* The *Nates* and *Teſtes* deſerve this Name much better here than in the human Body with reſpect to each other. They are here alſo of different Colours, the *Nates* being of the Colour of the *Cortical*, and the *Teſtes* of the *Medullary* Subſtance of the Brain: Whereas in Man they are both of one Colour. The Reaſon of theſe Differences, and others of the like Nature to be met with, I ſhall not pretend to determine; for we have hitherto ſuch an imperfect Knowledge of the Brain itſelf, that we are entirely ignorant of the various Uſes of it's different Parts; we may in general conclude, that the varying in one Animal, from what it is in another, is fitted to the Creature's particular Way of living.

Rete Mirabile Galeni.

The *Rete Mirabile Galeni*, ſituated on each Side of the *Sella Turcica*, about which there has been ſo much Diſpute, is more remarkable in *Quadrupeds* than in the human Subject, though it's certainly to be found there too; notwithſtanding ſeveral Anatomiſts have denied it's Exiſtence. The Uſe indeed which *Galen* aſcribes to it is frivolous, and not well grounded; for he will have this *Plexus* of Veſſels ſerve for checking the Impetuoſity of the Brain, but it is evident this cannot be the Uſe of it; if indeed the whole *Carotid Artery* had ſplit into ſuch ſmall Veſſels as compoſe this Network, the Motion of the Blood would certainly have been retarded in it; but this is not the Caſe, for it only ſends off a few ſmall Twigs to compoſe the *Plexus* at it's Entry into the *Cranium*, and the Branches going out from this ſame *Plexus*, are diſtributed to the neighbouring Nerves: Among the reſt it gives ſome Twigs to the *Ophthalmic* Branch of the fifth Pair. It is this Diſtribution of theſe Arteries makes it ſo difficult to determine whether there is a Communication between the *Intercoſtal* and that Nerve; for if you diſſect the Parts in a recent Subject, you would at firſt View affirm, that there is an *Anaſtomoſis*; but when the *Carotid Artery* is injected, and the *Plexus* filled with the ſubtile Liquor, theſe Branches, which formerly ſeemed to be Nerves, have now the Appearance of Arteries by the Veſſels of their Coats being injected. I have been at great Pains to enquire into the Matter, but could never poſitively determine if there is ſuch an *Anaſtomoſis* as is deſcribed by a great many Authors, and ſo very diſtinctly delineated by Dr. *Lower* in *Willis*'s Treatiſe of the Nerves, and by Mr. *Vieuſſen*, only it ſeems moſt probable from the Sympathy obſervable between them that there is ſuch an *Anaſtomoſis*.

The Structure of the Brain differing but very little in all *Quadrupeds*, it will be needleſs to examine it in any other.

The Anatomy of a Cow.

THE next Species of *Quadrupeds* we propoſed to conſider was the ruminant Kind, of which we have an Example in a Cow, and accordingly ſhall take the *Fœtus* of the Animal *in Utero*, that we may firſt remark ſome Things that are peculiar to it in that State, and afterwards proceed to examine it's *Viſcera* as a ruminant Animal; firſt then as a *Fœtus*.

Uterus. The Form of a Cow's *Uterus* differs from the Human, in having two pretty large *Cornua*. This is common to it with other Brutes, for a Bitch has two long *Cornua Uteri*; but theſe again differ (as being *Multiparous* and *Uniparous*) in this, that in the Bitch's *Cornua* the *Fœtus's* are contained, whereas here there is only Part of the *Secundines*, being moſtly the *Allantois* with the included Liquor. The muſcular Fibres of the *Uterus* are more eaſily diſcovered; it's internal Surface has a great Number of ſpungy, oblong, protuberant, glandular Bodies fixed to it by a fine *Membrane*: Theſe are compoſed of the ſeveral large Veſſels of the *Uterus* terminating here. Theſe are very ſmall, and ſometimes not to be obſerved at all. In an impregnated *Uterus*, we can eaſily preſs out of them a *Chylous Mucilaginous* Liquor; they are compoſed of a great many Proceſſes or *Digituli*, and deep Caverns anſwering to as many Proceſſes and Caverns of the *Placenta*. Their

Cornua Uteri.

Reſemblance has occaſioned the Name of *Papillæ* to be given them, and hence it was that *Hippocrates* was induced to believe, that the *Fœtus* ſuck'd in *Utero.* It is not eaſy to determine, whether the *Uterus* grows thicker or thinner in the Time of Geſtation. The *Membranes* it is plain (by the ſtretching of the Parts) muſt be made thinner, but then it is as evident, that the Veſſels are at that Time enlarged, upon which principally the Thickneſs of any Part depends; ſo there ſeems to be as much gained the one Way, as loſt the other. The *Os Uteri* is entirely ſhut up by a glutinous mucilaginous Subſtance, that is common to the Females of all Creatures when with Young; by this the external Air is excluded, which would ſoon make the Liquors corrupt, it alſo prevents the Inflammation of the *Membranes,* and the Hazard of Abortion. By this Means alſo the Lips of the Womb are kept from growing together, which otherwiſe they would certainly at this time do. There are *Mucous* Glands

Uterus if thicker in Time of Geſtation.

placed here to ſecern this *Gluten*, which on the breaking of the *Membranes* with the contained Waters make a *Sapo* that lubricates and waſhes the Parts, and makes them eaſily yield. The firſt of the proper *Involucra* of the *Fœtus* is the *Chorion*.

Chorion.

The *Chorion* is a pretty ſtrong firm *Membrane*, on whoſe external Surface are diſperſed a great many red fleſhy Bodies of the ſame Number, Size and Structure with the *Papillæ*, with which they are mutually indented. They have been called *Cotyledones* from Κοτύλη Cavity. This is greatly diſputed by ſome as a Name very improper, but I think without Reaſon, ſince the Surface that is connected to the *Papillæ* is concave, though when ſeparated it appears rather convex. To ſhun all Diſpute, they may be called properly enough *Placentulæ*, ſince they ſerve the ſame Uſe as the *Placenta* in Women. The Separation of theſe from the *Papillæ* without any Dilaceration ſeems to prove beyond a Reply, that there can be here no *Anaſtomoſes* betwixt the Veſſels;

Cotyledones.

on their Coats run a great Number of Veſſels that are ſent to the ſeveral *Placentulæ*, on the external Side next to the *Uterus*; whereas in Creatures that have but one *Placenta*, as in the human Subject, Cats, Dogs, *&c.* the Adheſion is ſomewhat firmer: The *Placentæ* are likewiſe joined to the *Papillæ* in the *Cornua Uteri*. We ſhall next give the Hiſtory of the *Allantois*.

Allantois. This is a fine tranſparent *Membrane* contiguous to the former. It is not a general *Involucrum* of the *Fœtus* in the Mother, for it covers only a ſmall Part of the *Amnios*: It is moſtly lodged in the *Cornua Uteri*. In Mares, Bitches and Cats it ſurrounds the *Amnios*, being every where interpoſed betwixt it and the *Chorion*. In Sheep and Goats it is the ſame as in this Animal; and in Swine and Rabbits it covers ſtill leſs of the *Amnios*. This Sac is probably formed by the Dilatation of the *Urachus*, which is connected at it's other End to the *Fundus* of the Bladder, through which it receives it's Contents, and the *Membrane* is doubled at the Extremity of the Canal to hinder the Return of the Urine back into the Bladder. It's Veſſels are exceſſively fine and few, and we cannot force an injected Liquor farther than the Beginning of this Coat. This *Membrane* is ſo far analogous to the *Cuticula*, as not to be liable to Corruption, or eaſily irritated by acrid Liquors. The Exiſtence of this *Membrane* in Women has been very warmly diſputed on both Sides: Thoſe who are againſt it's Exiſtence deny they could ever find it, and allowing it were ſo, alledge, that ſince the *Urachus* is impervious, as appears by our not being able to throw Liquors from the Bladder into it, or *Vice Verſa*, it cannot ſerve the Uſe, that is agreed by all it does ſerve in Beaſts, and therefore in the human Body there is no ſuch Thing: But if we conſider on the other Hand, that firſt there ſeems to be the ſame Neceſſity for ſuch a Reſervoir in Man, as in other Animals. Secondly, That we actually find Urine contained in the Bladder of the

The Arguments for and againſt the human Allantois.

the human *Fœtus.* Thirdly, That Urine has been evacuated at the Navel when the *Urethra* was ſtopped, which Urine without this Conduit would have fallen into the Cavity of the *Abdomen.* Fourthly, that Midwives do generally remark two different Sorts of Waters come away at the Time of Birth; and laſtly, That Dr. *Littre* and Dr. *Hale* have given in this *Membrane* of an human Subject with all the other Secundines curiouſly prepared, the one to the Royal Academy at *Paris*, the other to the Royal Society at *London*, by which Societies their reſpective Accounts are atteſted, not to mention *Verheyen*, *Heiſter*, *Keil*, &c. who affirm their having ſeen it, and Mr. *Albinus*, that famous Anatomiſt, Profeſſor at *Leyden*, ſhows, as I am told, to his College every Year a Preparation of it. On all theſe Accounts I muſt own, that it ſeems moſt probable to me there is ſuch a *Membrane* in the human Body, although in four Bodies I purpoſely diſſected, wherein I was aſſiſted by a very accurate Anatomiſt, Dr. *S——r*, I could not obſerve any ſuch thing; however, I would rather accuſe my own Want of Skill, than doubt the Truth of Relations ſupported by ſuch authentic Vouchers.

Amnios. The third proper Integument of the *Fœtus* is the *Amnios*; it is thinner and firmer than the *Chorion*; it has numerous Ramifications of the umbilical Veſſels ſpread upon it, the lateral Branches of which ſeparate a Liquor into it's Cavity. This is the proper Liquor of the *Amnios*, which at firſt is in a ſmall Quantity, afterwards encreaſes for ſome Months, then again decreaſes; and in a Cow near her Time the Quantity of this Liquor is not above a Pound. This *Membrane* does not enter the *Cornua Uteri* in this Creature; but for what further relates to the Structure of the *Involucra*, with the Nature of the Liquors contained in them, I muſt refer to the ſecond Volume of Medical Eſſays, from Page 121, where you have the Sum of all we know of this Matter.

Then are here two *Venæ Umbilicales*, and but one in the human Subject, becauſe the extreme Branches coming from the ſeveral *Placentulæ* could not unite, ſo ſoon, as they would have done had they come all from one Cake as in the Human.

There's a ſmall round fleſhy Body that ſwims in the Urine of this Creature, Mares, *&c.* called *Cuticula*, which is the *Hypomenes* of the Ancients. Several idle Opinions and Whims have been entertained as to it's Uſe, but that ſeems to be ſtill unknown, or how it's generated or nouriſhed, for it has no Connection with the *Fœtus* or *Placentulæ*.

Having thus conſidered the ſeveral *Involucra* of this Animal in a *Fœtus* State, let us next obſerve the Specialities in it's internal Structure peculiar to a *Fœtus*.

Vena Umbilicalis.

The umbilical Vein joins the *Vena Portarum* in the *Capſula Gliſſoniana* without ſending off any Branches as it does in the human Subject. This Vein ſoon after Birth turns to a Ligament, yet there are ſome Inſtances where it has remained pervious for ſeveral Years after Birth, and occaſioned an Hemorrhage. We may next obſerve the Duct called *Canalis Venoſus*, going ſtraight from the *Capſula Gliſſoniana* to the *Vena Cava*; this turns alſo afterwards to a Ligament. The umbilical Arteries riſe at acute Angles from the internal Iliacks, whatever ſome may ſay to the contrary: Theſe alſo become impervious.

Canalis Venoſus.

The pulmonary Artery coming from the right Ventricle of the Heart divides into two, the ſmalleſt called *Canalis Arterioſus* opens into the deſcending *Aorta*; the other divides into two, to ſerve the Lungs on each Side. The *Foramen Ovale* is placed in the Partition betwixt the right and left Auricles.

Foramen Ovale.

cles. At the Edge of this Hole is fixed a *Membrane,* which when much ſtretched will cover it all over, but more eaſily yields to a Force that acts from the right Auricle to the left, than from the left to the right. After what has been ſaid we may eaſily underſtand how the Circulation is performed in a *Fœtus.* The Blood being brought from the *Placenta* of the Mother, is thrown into the *Capſula Gliſſoniana,* where it is intimately blended with the Blood in the *Vena Portarum:* then part of this Blood goes directly into the *Vena Cava* by the *Ductus Venoſus,* the reſt paſſes through the Liver. Firſt then the whole is ſent from the *Vena Cava* into the right *Auricle,* from whence part of it is ſent by the *Foramen Ovale* into the left *Auricle,* the reſt paſſes into the right Ventricle, then into the *Pulmonary* Artery, then the greateſt Share it receives is ſent immediately into the deſcending *Aorta* by the *Canalis Arterioſus,* and the Remainder circulates through the Lungs and is ſent back by the *Pulmonary* Veins

The Circulation, how performed in a Fœtus.

Veins into the left *Auricle*, which with the Blood brought there by the *Foramen Ovale* is ſent into the left Ventricle, from whence it is driven by the *Aorta* through the Body. The great Deſign of this Mechaniſm is, that the whole Maſs of Blood might not paſs through the collapſed Lungs of the *Fœtus*, but that Part of it might paſs through the *Foramen Ovale* and *Canalis Arterioſus* without circulating at all through the Lungs.

eſſieurs ery *and* inſlow, *eir Opi- ons of it amined.*

This was the Opinion that univerſally prevailed till the End of the laſt Century, when it was violently oppoſed by Monſieur *Mery*, who is very ſingular in ſeveral of his Opinions. He will not allow that the *Foramen Ovale* tranſmits Blood from the right to the left *Auricle*, but on the contrary from the left to the right, and that for no other Reaſon but becauſe he obſerved the *Pulmonary* Artery in a *Fœtus* longer than the *Aorta*: Mr. *Winſlow* endeavours to reconcile theſe two Opinions, by ſaying the Blood may paſs either Way, and that it is here as it were blended; his Reaſon is, that on putting the Heart in Water, the *Foramen Ovale* tranſmits it any Way. Mr. *Rohault*, Profeſſor of Anatomy at *Turin*, and formerly one of *Mery*'s Scholars, ſtrongly defends his Maſter and criticiſes Mr. *Winſlow*. What he principally builds on is the Appearance this *Foramen* has in ſome dry'd Preparations: This Mr. *Winſlow* won't allow as a Proof. After all I remain in the common Opinion, and that for the following Reaſons; firſt the *Pulmonary* Artery being larger ſignifies nothing, ſince it's Coats are not only thinner, and will be more eaſily diſtended, but alſo the Reſiſtance to the Blood in the *Pulmonary* Artery from the collapſed Lungs is greater than the Reſiſtance to the Blood in the *Aorta*. Secondly, if we ſhould allow any of theſe two uncommon Opinions, we ſhould have the right Ventricle vaſtly more capacious than the left; for if we ſuppoſe the *Foramen Ovale* to be capable of tranſmitting one half of the whole Maſs of Blood in any given Time, and the *Arterioſus* as much in the ſame Time, then you'll find that according to Mr. *Mery*'s Opinion, the whole Maſs of Blood being driven from the right Ventricle into the *Pulmonary* Artery, one third paſſes by the *Canalis Arterioſus* into the deſcending *Aorta*, two thirds paſſing through the Lungs and returning into the left *Auricle*, one half of it, or one third of the whole Maſs paſſes by the *Foramen Ovale* into the right *Auricle*, and the other or the laſt third will be ſent into the left Ventricle, and thence expelled into the *Aorta*; which third, with that from the *Pulmonary* Artery by the *Canalis Arterioſus*, circulating through the Body, are returned unto the right *Auricle*, where meeting with the other third from the *Foramen Ovale*, with it are ſent into the right Ventricle, to undergo the ſame Courſe. Thus the whole Maſs is expelled by the right Ventricle and only one third by the left. If this was the Caſe, why is not the right Ventricle three times as large and ſtrong as the left? Then if according to Mr. *Winſlow*'s Syſtem the *Foramen Ovale* tranſmits equal Quantities from both *Auricles*, this comes to the ſame as if there was no *Foramen Ovale* at all; that is to ſay, the whole Maſs going from the right *Auricle* into the right Ventricle and *Pulmonary* Artery, one third of the whole Maſs paſſes into the *Aorta* thro' the *Canalis Arterioſus*, the other two thirds paſſing through the Lungs return to the left Ventricle and *Auricle*, to be ſent through the *Canalis Arterioſus* to the right Ventricle to undergo the ſame Fate; thus the right Ventricle expels the whole Maſs, the left only one third; but if according to the common Opinion we ſuppoſe the *Foramen Ovale* to convey the Blood from the right to the left *Auricle*, then one third paſſes this Way into the left Ventricle, the other two thirds are ſent by the right Ventricle into the *Pulmonary* Artery, from whence one third paſſes by the *Canalis Arterioſus* into the *Aorta deſcendens*, the other third circulates through the Lungs and is returned into the left Ventricle, where meeting with that from the *Foramen Ovale* is with it expelled into the *Aorta*, and with the one third tranſmitted by the *Canalis Arterioſus* returns into the *Auricle* to run the ſame Race as before. Thus we conclude that two thirds are expelled by each Ventricle and the whole circulates thro' the Body; and hence they come to be of pretty equal Dimenſions. In all this Calculation I have had no regard to the Blood diſcharged from the *Umbilical* Veſſels; but the greater Quantity returned by the Veins, than ſent out by the Arteries, ſtill argues for the common Opinion.

The Kidneys.

The Kidneys in the *Fœtus* are compoſed of different Lobes, which ſerves to give us an Idea of the Kidneys being a Congeries of different Glands; theſe Lobes being kept contiguous by the external *Membrane* are preſſed by the other *Viſcera* till at Length they unite.

We come now to conſider the Creature as a ruminant Animal. There are no *Dentes Inciſores* in the Upper Jaw, but the Gums are pretty hard, their Tongue rough, and they ſupply this Defect by wrapping their Tongue round a Tuft of Graſs, ſo preſſing it againſt the Upper-Jaw keep it ſtretched, and cut it with the Teeth of the Under-Jaw; then, without chewing, throw it down into the *Oeſophagus*, which in theſe Creatures conſiſts of a double Row of *Spiral Fibres* decuſſating one another. All Animals which ruminate muſt have more Ventricles, than one, ſome have two, ſome three, our preſent Subject has no leſs than four. The Food is carried directly down into the firſt, which lies upon the Left-ſide and is the largeſt of all; it is called γάστηρ *Ventriculus*, and κοιλία by way of Eminence. It is what is called by the general Name of Paunch by the Vulgar. There are no *Rugæ* upon it's internal Surface; the Food, by the Force of it's muſcular Coat,

The Hiſtory of it as a ruminant Animal.

It has four Stomachs.

Their Names and Deſcription.

and the Liquors poured in here, is ſufficiently macerated, after which it is forced up hence by the *Oeſophagus* into the Mouth, and there it is made very ſmall by Maſtication; this is what is properly called Chewing the Cud or Rumination; after this it is ſent down by the Gullet into the ſecond, for the *Oeſophagus* opens indifferently into both; however the Creature has a Power to direct it into which it will. Some tell us that the Drink goes into the ſecond, but that might be eaſily determined by making them drink before Slaughter; the ſecond Stomach, which is the anterior and ſmalleſt, is called κεκρύφαλος *Reticulum*, the *Bonnet*, or *King's-Hood*. It conſiſts of a great Number of Cells on it's internal Surface of a regular *Pentagonal* Figure, like to a Honey-comb. Here the Food is farther macerated, from which it is protruded into the third, called Εχῖνος or *Omaſum*, *vulgo* the *Manyplus*, becauſe the internal Surface riſes up into a great many *Plicæ* or Folds, and *Stratum ſuper Stratum*, according to the

Length of this Stomach. Some of theſe *Plicæ* are further produced into the Stomach than others, *i. e.* firſt two long ones on each Side, and within theſe, two ſhorter in the middle, *&c.* There are ſeveral Glands in this Stomach which is next to the Κοιλία in Bigneſs, and from this it paſſes into the fourth, whoſe Names are Ἤνυστρον *Abomaſum*, *Caille*, or the *Red*, which is the name it commonly has becauſe of it's Colour. *Caille* ſignifies curdled, and hence the *French* have given that as a Name to this fourth Stomach, becauſe any Milk that is taken down by young Calves, from the long *Remora* it makes here, turns acid; and by the Remains of the Milk before taken down aſſiſting, it is curdled. It is this fourth Stomach with the Milk curdled in it, that is commonly taken for earning of Milk (as they call it) but after the *Bile* and *Pancreatic* Juice enter, this Coagulation is not to be ſound, which ſhews the Uſe of theſe Liquors. There are other Creatures that uſe the ſame Food, that have not ſuch a Mechaniſm in their digeſtive Organs; Horſes, Aſſes, *&c.* have but one Stomach where Graſs is macerated, and a Liquor for their Nouriſhment extracted, and the Remainder ſent out by the *Anus* very little altered. From this different Structure of the Stomach in theſe Creatures, a ruminant Animal will be ſerved with one third leſs Food than another of equal Bulk; Graſiers are ſufficiently acquainted with this. The Reaſon is, that ruminating Animals have many and ſtrong digeſtive Organs; all their Food is fully prepared and almoſt wholly converted into *Chyle*, but a Horſe's Stomach is not fitted for this, ſo that they require a much greater Quantity of Food to extract the ſame Nouriſhment.

Inteſtina. The Guts of theſe Creatures are of a conſiderable Length in Proportion to the Bulk of the Animal's Body, and this confirms what we ſaid formerly on the Subject of the *Inteſtines* of a Dog, *viz.* that the Length and Capacity of the Guts were different in different Animals according to the Nature of their Food.

The *Duodenum* is formed here much the ſame Way as in a Dog, and the general Intention kept in View, with regard to the Mixture of the *Bile* and *Pancreatic Lymph*. The great Guts here hardly deſerve that Name, their Diameter differing very little from that of the ſmall ones; but to compenſate this, they are much longer proportionally than a Dog's are, being convoluted in the ſame Way as the ſmall Guts are. The *Cæcum* is very large. ***Duodenum.***

The *Spleen* differs not much either in Figure or Situation from that of a Dog's, but it is a little more firmly fixed to the *Diaphragm*, there not being here ſo much Danger of this *Viſcus*'s being hurt in the *Flexions* of the *Spine*. ***Spleen.***

The *Liver* is not ſplit into ſo many *Lobes* in this Creature as either in a ***Liver.***

Man or Dog, which depends on the ſmall Motion this Creature enjoys in it's *Spine*, which made ſuch a Diviſion needleſs: This alſo confirms what I formerly advanced on this Head.

Bladder. Their *Veſica Urinaria* is of a pyramidal Shape, and has ſcarce any *muſcular Fibres*. It is very large and membranaceous, for the Urine of theſe Creatures not being ſo acrid as that of *carnivorous* Animals, there was no ſuch Occaſion for expelling it ſo ſoon.

Scrotum. Veſiculæ Seminales. This Creature is provided with a looſe pendulous *Scrotum*, and conſequently with *Veſiculæ Seminales*. The Female Organs differ from thoſe of a Bitch, moſtly as to the Form of the *Cornua Uteri*, which are here converted in Form of a Snail. In this and all uniparous Animals they contain only Part of the *Secundines*, but in Bitches and other multiparous Animals they run ſtreight up in the *Abdomen*, and contain the *Fœtus* themſelves.

Cor The Situation of the Heart is pretty much the ſame with that of a Dog, only it's Point is rather ſharper; in us the Heart beating continually againſt the Ribs, and both *Ventricles* going equally far down to the Conſtitution of the *Apex* it is very obtuſe, but here the *Apex* is made up only of the left *Ventricle*, ſo is more acute.

Aorta aſcendens and deſcendens.

The *Aorta* in this Creature is juſtly divided into aſcending and deſcending, though this Diviſion is ill founded either in a Dog or Man, and it has certainly been from this Subject that the older Anatomiſts took their Deſcriptions when they made this Diviſion; for here the *Aorta* divides into two, the aſcending and deſcending; the deſcending runs upwards or forwards, according to their Poſture, for two or three Inches, before it gives off the left *Subclavian*, and ſtill an Inch or more before the right *Subclavian* comes off, and yet ſomewhat further before it divides into the two *Carotids*, ſo that the Veſſels that go to the anterior Extremity of the Right-ſide, do ſtill keep longer in a common Trunk with the *Carotids* than thoſe on the Left.

Of Fowls in General.

THE next Claſs of Animals we come to conſider, are the feathered Kind; which are divided into the *Granivorous* and *Carnivorous*. But before we go on to conſider the Specialties in the *Viſcera* of each Kind, we muſt obſerve what both Species agree in.

Their Covering. Fowls have a particular Covering of *Feathers* different from all other Creatures, but exactly well ſuited to their Manner of Life; for it not only protects them from the Injuries of the Weather, but ſerves them in their Progreſſion through that thin aerial Element, they are for the moſt Part employed in; and as ſome Fowls live much in the Water, their Feathers being continually beſmeared with an oily Liquor, keeps the Water from ſoaking into their Skins, and ſo prevents it's bad Effects, which it would infallibly otherwiſe produce.

Their Wings, how furniſhed.

Fowls have the ſtrongeſt Muſcles of their whole Body inſerted into their Wings; whence by the Way we may obſerve that it is altogether impoſſible for Man to buoy himſelf up into the Air like Birds, even though he had proper Machines in place of Wings, unleſs he were likewiſe provided with Muſcles ſtrong enough for moving them, which he has not. In the next Place their Wings are not placed in the Middle of their Bodies, but a good deal further forwards, whence it would at firſt View appear that their Heads would be erect, and their Poſterior Parts moſt depending, when raiſed in the Air; but by ſtretching out their Heads, which act upon the *Lever* of a long Neck, they alter their Center of Gravity pretty much, and alſo by filling the Sacs or Bladders in the Inſide of their *Abdomen*, with Air, and expanding their Tail, they come to make the Poſterior Part of their Bodies

Why not placed in the Middle of the Body.

dies conſiderably higher, and thus they fly with their Bodies near in an horizontal Situation. Hence we find, that if their Necks are kept from being ſtretched out, or if you cut away their Tails, they become incapable of flying any conſiderable Way. The Largeneſs of the Wings in different Fowls varies, according to the Occaſions of the Creature. Thus Birds of Prey, who muſt fly a conſiderable Way to provide their Food, have large ſtrong Wings; whereas domeſtic Birds, who find their Nouriſhment almoſt every where, have very ſhort and but ſmall Wings. The beſt Account of the Manner of Progreſſion of Fowls, is given by *Alfonſus Borellus*, in his Treatiſe *De Motu Animalium*, and in the *Religious Philoſopher* we have *Borelli*'s Doctrine ſtript pretty much of it's Mathematical Form. The Poſterior Extremities are ſo ſituated as to make us at firſt think they would be in continual Hazard of falling down forwards when they walk, but this is prevented by their holding up their

Heads and Necks, and when they have Occaſion for climbing up a ſteep Place, they ſtretch out their Head and Necks forwards. Thus we may obſerve a Gooſe, entering a Barn-door, where generally there is an aſcending Step, to ſtretch out it's Neck, which before was raiſed, and incline it's Body forwards; this is laughed at by the common People, who aſcribe it to a piece of Folly in the Gooſe, as if afraid of knocking it's Head againſt the Top of the Door.

Carnivorous Animals are provided with ſtrong crooked Claws for the catching their Prey; Water Fowls uſe them for Swimming, and principally for this Purpoſe have a ſtrong firm *Membrane* interpoſed betwixt the Toes. There is a beautiful Mechaniſm to be obſerved in the Toes of Fowls, which is of conſiderable uſe to them; for their Toes are naturally drawn together or bended when the Foot is bended; this perhaps proceeds from the Tendons of the Toes paſſing over in

A peculia
Mecha-
niſm in th
Toes of
Fowls.

in them, which is analogous to our Heels, and when the Foot is bended muſt conſequently be much ſtretched; and ſince they are inſerted into the Toes, muſt of Neceſſity bend them when the Foot is bended, and when the Foot is extended the *Flexors* of the Toes are again relaxed, and they therefore expanded. This is of great Uſe to Water Fowls, for had there been no ſuch Contrivance as this, they muſt have loſt as much Time when they pulled their Legs in, as they had gained by the former Stroke; but as the Parts are now framed, whenever the Creature draws in it's Foot, the Toes are at the ſame Time bended and contracted into leſs Space, ſo that the Reſiſtance made againſt the Water is not near ſo great as before: On the contrary, when they ſtretch their Foot their Toes are extended, the *Membrane* betwixt them expanded, and conſequently a greater Reſiſtance made to the Water. Again, ſuch Fowls as live moſtly in the Air, or have Occaſion to ſuſtain themſelves on Branches of Trees in windy Weather, and even in the Night-time when aſleep, while all their Muſcles are ſuppoſed to be in a State of Relaxation; ſuch, I ſay, have no more to do, but lean down the Weight of their Bodies, and their Toes continue bended without any Muſcles being in Action; and whenever they would diſentangle themſelves, they raiſe up their Bodies, by which their Foot, and conſequently their Toes, are extended.

The Variety in the Beaks of Fowls. It's Uſes, &c.

Carnivorous Fowls have their Beaks long, ſharp and crooked; the domeſtick Fowls, ſuch as the Hen Kind, *&c.* have ſtrong ſhort Beaks, commodiouſly fitted to dig up and break their Food; the Water Fowls again have long or very broad Scoop-like Beaks, which is moſt convenient for them. The *Sternum* of Fowls is much larger proportionally than the Human, and has a Ridge riſing in it's Middle for the more commodious Origin of the Muſcles that move the Wings. It is alſo leſs moveable than ours, for had it been very moveable, a great deal of the Force employed for moving the Wings would at every Contraction of the Muſcles have been loſt, or elſe ſome other Muſcles muſt have come in Play to keep firm the *Sternum*, but this additional Weight would have been inconvenient for their Progreſſion.

What other Things are moſt remarkable in the Structure of the ſeveral *Viſcera*, we ſhall conſider in that common domeſtic Animal, the Cock or Hen, and afterwards obſerve the Difference of their *Viſcera Chylopoietica* from a *Carnivorous* Fowl.

The Anatomy of a Cock.

Oeſophagus. *Ingluvies.* THE *Oeſophagus* of this Creature runs down it's Neck ſomewhat inclined to the Right-ſide, and terminates in a pretty large *Membranous Sac*, which is the *Ingluvies* or Crop where the Food is macerated and diſſolved by a Liquor, ſeparated by the Glands which are eaſily obſerved ed every where on the external Surface of this Bag. The Effect of this Maceration may be very well obſerved in Pigeons, who are ſometimes in Danger of being ſuffocated by the Peaſe, *&c.* they feed upon, ſwelling to ſuch an immenſe Bulk in their *Ingluvies,* that they can neither get upwards nor downwards. If it be a favourite Fowl, it might be preſerved by opening the *Sac,* taking out the Peaſe and ſewing up the Wound.

Ventriculus Succenturiatus ſeu Infundibulum.

The Food getting out of this *Sac,* goes down by the remaining Part of the *Oeſophagus* into the *Ventriculus Succenturiatus* or *Infundibulum Peyeri,* which is a Continuation of the Gullet with more numerous Glands, which ſeparate a Liquor to dilute the Food ſtill more, which at Length gets into the true Stomach or Gizzard, which conſiſts of two very ſtrong Muſcles covered externally with a *tendinous Aponeuroſis,* and lined on the Inſide by a very thick firm *Membrane,* which we evidently diſcover to be a Production of the *Cuticula.*

ticula. This might have been proved in ſome Meaſure a priori, from taking Notice that this *Membrane,* which in Chicks is only a thin ſlight *Pellicle,* by Degrees turns thicker and ſtronger, the more Attrition it ſuffers: but there is no other Animal Subſtance, ſo far as we know, which grows more hard and thick by being ſubjected to Attrition, excepting the *Cuticula*. Hence may be drawn ſome kind of Proof of what I have ſometimes affirmed concerning the *Tunica Villoſa* of the Stomach, and *Inteſtines* in the human Body, *viz.* that it was only a Continuation of the *Epidermis*. Nay, all the hollow Parts of the Body, even Arteries, Veins, *&c.* ſeem to be lined with a Production of this *Membrane* or one *analogous* to it. The Uſe of this internal Coat of the Stomach of Fowls is to defend the more tender Parts of that *Viſcus* from the hard Grains and little Stones thoſe Creatures take down.

Epidermis inveſts the internal Surface of all the Cavities and Veſſels of the human Body.

The Digeſtion of theſe Animals is performed merely by Attrition, as is evinced by many Experiments. We ſee them daily take down conſiderable Numbers of the moſt ſolid rugged little Flints they find, and theſe can ſerve for no other Purpoſe than to help the Trituration of their Aliments. After theſe Pebbles by becoming ſmooth are unfit for this Office, they are thrown up by the Mouth; hence Fowls that are long confined, though never ſo well fed, turn lean for want of theſe Stones to help their Digeſtion; but this was put beyond all Diſpute by Mr. *Tauvry*, who gave a Species of Metal to an Oſtrich, convex on one Side, and concave on the other, but carved on both; and opening the Creature's Body ſome Time after, it was found that the carving on the convex Side was all obliterated, while the engraved Character remained the ſame as before on the concave Side which was not ſubjected to the Stomach's Preſſure; which could not have happened had Digeſtion been performed by a *Menſtruum*, or any other Way whatſoever; but may be eaſily ſolved by

Diſpute about Digeſtion in the human Body, if performed by Attrition ſolely, or a Menſtruum.

allowing a ſimple Mechanical Preſſure to take Place. We are however by no Means to conclude from this, as ſome have too raſhly done, that in the human Body Digeſtion is performed by a ſimple Attrition, otherwiſe we may with equal Strength of Reaſon, by as good Arguments drawn from what is obſerved in Fiſhes, prove that the Aliments are diſſolved in our Stomachs by the Action of a *Menſtruum:* But this Method of reaſoning is very faulty, nor can it ever bring us to the true Solution of any philoſophical or medical Problem. 'Tis very plain ſince the Structure of the Parts of the human Stomach are ſo very different from that of this Creature, that it is fooliſh and unreaſonable to imagine both of them capable of producing the ſame Effects. At each End of the Stomach, there are as it were two particular Sacs of a different Texture from the reſt of the Stomach, not conſiſting of ſtrong *Muſcular Fibres;* they ſeem to be Receptacles for the Stones (eſpecially at the End which is fartheſt from the Orifice) while the digeſted Aliment is protruded into the *Inteſtines*.

The *Duodenum* begins pretty near the ſame Place, at which the *Oeſophagus* enters; yet notwithſtanding the Vicinity of theſe two Tubes, the Aliments are in no Danger of getting out before they are perfectly digeſted, by reaſon of a Protuberance or *Septum Medium* betwixt the Orifices; and in thoſe Creatures who have ſuch a ſtrong muſcular Stomach, 'tis a Matter of great Indifference, whether the Entry of the *Oeſophagus* or *Pylorus* be higheſt, provided that the Entry from the *Oeſophagus* does not allow the Food to regurgitate, ſince the Force of the Stomach can eaſily protrude it towards the *Duodenum*. This Gut is moſtly in the Right-ſide, and hangs pendulous in their *Abdomen*, having it's two Extremities fixed to the Liver. The *Ductus communis Choledochus* enters near it's Termination, where it mounts up again to be fixed to the Liver;

Duodenum.

Ductus Choledochus.

Liver; and leſt, by the Contraction of the *Inteſtines*, the *Bile* ſhould paſs over without being intimately blended with the *Chyle*, that *Duct* enters downwards contrary to the Courſe of the Food, and contrary to what is obſerved in any of the Animals we have mentioned yet. But ſtill the general Intention is kept in View, in allowing theſe Juices the faireſt Chance of being intimately blended with the Food.

nteſtina enuia.

The ſmall Guts are proportionally larger than thoſe of *Carnivorous* Birds, for the general Cauſe already aſſigned. At the End of the *Ilium* they have two large *Inteſtina Cæca*, one on each Side, which ſerve as Reſervoirs to the *Fæces*, which after ſome *Remora* there regurgitate into what ſoon becomes the *Rectum*, which, together with the Excretories of Urine, and Organs of Generation, empties itſelf into the common *Cloaca*. The ſmall *Inteſtines* are connected by a long looſe *Meſentery*, which has little or no Fat accompanying the Blood Veſſels,

ſels, there being no Hazard of the Blood's being ſtopped. There are no Lacteal Veſſels, *Glandulæ Vagæ* or *Pancreas Aſſellii* to be obſerved here. The *Meſeraic Veins* are proportionally very large, if you either compare them with the correſponding Arteries, or conſider them with reſpect to the Guts themſelves. The want of Lacteals, *&c.* is ſupplied by theſe Veins. As a Proof of theſe having a Communication with the Guts, in larger Fowls the Guts can be diſtended by blowing in at the *Meſeraic* Vein; and from this Difference of Structure, the Uſe of the *Glandulæ Vagæ*, &c. can eaſily be aſſigned, *viz.* the *Chyle* in theſe Animals, that have Lacteals, being to be mixed with the Blood in a conſiderable Quantity at a Time, leſt it's Particles ſhould attract one another too ſtrongly, and ſo hinder this Mixture; it was therefore neceſſary it ſhould be well diluted by the *Humores Inquilini*, which bear a very great Proportion to the Quantity of pure *Chyle*; ſince the *Lymph* from the inferior Extremities,

Lacteal Veſſels, how ſupplied.

Their Uſe in other Animals.

ties, *Abdominal Viſcera*, Neck, *&c.* are poured into it. Here there was no Hazard of any ſuch Inconveniency by the *Chyle* being mixed with the Blood in ſmall Proportion from the immenſe Number of the ſmall Extremities of the *Meſeraic* Veins.

Pancreas. The *Pancreas* in the Creature lies betwixt the two Folds of the *Duodenum*, and ſends two or three *Ducts* into this Gut pretty near the *Biliary*.

The Spleen. The Spleen is here of a round globular Figure, ſituated between the Liver and Stomach, and betwixt theſe and the Back-bone it enjoys the ſame Properties as in other Animals, *viz.* large Blood Veſſels, *&c.* All it's Blood is ſent into the *Vena Portarum*, and has a perpetual Conquaſſation. It has no Excretory as far as we know. Their *Liver.* Liver is divided into two equal Lobes by a *Pellucid Membrane*, running according to the Length of their Body; and hence we may obſerve, that it is not proper to that Bowel to lye on the Right-ſide, which is ſtill more confirmed by what we obſerve in Fiſhes, where it almoſt lies in the Left-ſide.

Veſica fellis.

The Shape of their Gall-Bladder is not much different from that of *Quadrupeds*, but is thought to be longer in Proportion to the Size of the Animal, and is farther removed from the Liver; though in Fiſhes it is ſtill further removed, not being at all contiguous; and in them the *Ductus Hepaticus* and *Cyſticus* don't unite till juſt at the Entry into the Gut. In theſe Animals, *viz.* Fiſhes, there ſeems to be no Way of the *Bile* getting into the Gall-Bladder but by Regurgitation.

Cor.

The principal Difference to be remarked in their Heart, is the want of the *Valvulæ Tricuſpides*, and their Place being ſupplied by one fleſhy Flap.

Pulmone their Structur and Uſe

The Lungs are not looſe within the Cavity of the *Thorax*, but fixed to the Bone all the Way; neither are they divided into Lobes, as in thoſe Animals that have a large Motion in their *Spine*. They are two red ſpongy

Bodies covered with a *Membrane* that is pervious, and communicates with the large *Veſicles* or Air Bags that are diſperſed over their whole *Abdomen*, which *Veſicles* ſerve two very conſiderable Uſes; the one is to render their Bodies ſpecifically light, when they have a Mind to aſcend and buoy themſelves up when flying, by diſtending their Lungs with Air, and alſo ſtraiten their *Trachea Arteria* and ſo return the Air.

The Uſe of the Veſicles in the Abdomen.

he Diaphragm, ow ſupplied.

Secondly, they ſupply the Place of a *muſcular Diaphragm* and ſtrong *Abdominal Muſcles*; producing the ſame Effects on the ſeveral contained *Viſcera*, as theſe Muſcles would have done without the Inconveniency of their additional Weight; and conducing as much to the Excluſion of the Egg and *Fæces*.

rachea rteria.

The *Trachea Arteria*, near where it divides, is very much contracted, and their Voice is principally owing to this Coarction. If you liſten attentively to a Cock crowing, you will be ſenſible that the Noiſe does not proceed from their Throat, but deeper; nay this very Pipe, when taken out of their Body and cut off a little, after it's Diviſion, and blown into, will make a ſqueaking Noiſe, ſomething like the Voice of theſe Creatures. On each Side, a little higher than this Contraction, there's a Muſcle ariſing from their *Sternum*, which dilates the *Trachea*. The *Cartilages*, of which the Pipe is compoſed in this Animal, go quite round it; whereas in Men and *Quadrupeds*, they are diſcontinued for about one fourth on the back Part, and the intermediate Space filled up by a *Membrane*. Neither is the *Trachea* ſo firmly attached to their *Vertebræ* as in the other Creatures we have examined. This Structure we ſhall find of great Service to them, if we conſider, that had the ſame Structure obtained in them as in us, their Breath would have been in Hazard of being ſtopped at every Flexion or twiſting of their Neck, which they are frequently obliged to. This we may be ſenſible of by bending our Necks conſiderably on one Side, upon which we ſhall find a great Straitneſs and Difficulty of Breathing; whereas their *Trachea* is better fitted for following the Flexions of the Neck by it's looſe Connection to the *Vertebræ:* and as from the Structure of the *Trachea* it cannot yield to every Cauſe diſtending the *Oeſophagus* as in us, it was proper they ſhould be placed at a greater Diſtance from each other, which we accordingly find they are.

In Place of a *muſcular Diaphragm*, this Creature has nothing but a thin *Membrane* connected to the *Pericardium*, which ſeparates the *Thorax* and *Abdomen*. But beſides this, the whole *Abdomen* and *Thorax* are divided by a longitudinal *Membrane* or *Mediaſtinum* connected to the Lungs, *Pericardium*, Liver, Stomach, and to the Fat lying over their Stomach and Guts, which is analogous to an *Omentum*, and ſupplies it's Place.

The Kidneys lye in the hollow excavated in the Side of the Back-bone, from which there is ſent out a blueiſh coloured Canal, running along by the Side of the *Vas deferens*, and terminates directly into the common *Cloaca*. This is the *Ureter*, which opens by a peculiar Aperture of it's own, and not at the *Penis*. This Creature having no *Veſica urinaria*, it was thought by ſome they never paſſed any Urine, but that it went to the Nouriſhment of the *Feathers*, but this is falſe; for that whitiſh Subſtance that you ſee their greeniſh *Fæces* covered with, and which turns afterwards chalky, is their Urine. Let us next conſider the Organs of Generation of both Sexes, and firſt thoſe of the Male. *Kidneys.*

The *Teſticles* are ſituated one on each ſide of the Back-bone, and are proportionally very large, to the Creature's Bulk. From theſe run out the *Vaſa Seminifera*, at firſt ſtreight, but after they recede farther from the Body of *The Organs of Generation in the Male.*

the *Teſticle* they acquire an undulated or convoluted Form, as the *Epididymis* in Man. Theſe Convolutions partly ſupply the want of *Veſiculæ Seminales*, their Coition being at the ſame Time very ſhort; theſe terminate in the *Penis*, of which this Creature has two, one on each Side of the common *Cloaca* pointing directly outwards, and are very ſmall and very ſhort, hardly ſo big as a Millet Seed; whence they have eſcaped the Notice of Anatomiſts, who have often denied their Exiſtence. This is what is chiefly remarkable in the Organs of the Male.

Vitellarium. The *Racemus Vitellorum* being analogous to the *Ovaria* in the human Subject, are attached by a proper *Membrane* to the Back-bone. This is very fine and thin, and continued down to the *Uterus*. It's Orifice is averſe with reſpect to the *Ovaria*, yet notwithſtanding, by the Force of the *Orgaſmus Venereus*, it turns round and graſps the *Vitellus*, which in it's Paſſage thro' this *Duct*, called the *Infundibulum*, receives a thick Gelatinous Liquor, ſecreted by certain Glands. This, with what it receives in the *Uterus,* compoſe the White of the Egg. By this Tube then it is carried into the *Uterus.*

Uterus.

The *Uterus* is a large Bag, placed at the End of the *Infundibulum,* full of Wrinkles on it's Inſide; here the Egg is completed, receiving it's laſt *Involucrum,* and the Shell is at laſt puſhed out at an Opening in the Side of the common *Cloaca.* From the *Teſtes* in the Male being ſo very large, in Proportion to the Body of the Creature, there muſt neceſſarily be a great Quantity of *Semen* ſecerned; hence the Animal is ſalacious, and becomes capable of impregnating ſo many Females. The want of the *Veſiculæ Seminales* is in ſome Meaſure ſupplied by the Convolutions of the *Vaſa deferentia,* and by the ſmall Diſtance betwixt the ſecerning and excretory Organs. The two *Penes* contribute alſo very much to their ſhort Coition, at which Time the Opening of the *Uterus* into the *Cloaca*

The want of the Veſiculæ Seminales, how ſupplied.

Cloaca is very much dilated, that the Effect of the *Semen* on the *Vitelli* may be the greater.

A Hen will of herſelf indeed lay Eggs, but theſe are not impregnated, and yet appear intirely complete, except that the ſmall black Spot, which comes afterwards to be the Rudiments of the Chick, is not here to be obſerved. After having obſerved the Contents of the *Abdomen* and *Thorax*, we next proceed to examine the Parts about the Neck and Head.

Tongue, it's Form.

Theſe Creatures, as was obſerved of Fowls in general, have no Teeth, which would have been needleſs, as they ſwallow their Food intire; but their Tongue is made pretty firm, leſt it ſhould be hurt by the ſharp Points of the Grain they feed on. It is of a triangular Figure and pointed before; and as by the depending Poſture their Meat is in Hazard of falling out of their Mouths, to prevent this, there are ſeveral ſmall pointed *Papillæ* ſtanding out upon their Tongue and Palate, with their Points inclined backwards, allowing an eaſy Paſſage to the Food, but hindering it's Return.

We have here no *Velum Palatinum*, *Uvula*, or *Epiglottis*, and in Place of two large Holes opening into the Noſe, there's only a long narrow *Rima* ſupplied with pretty ſtrong Muſcles, and ſuch another ſupplies the Place of a *Glottis*. The Creature has a Power of ſhutting both at Pleaſure, and the Nature of their Food ſeems not only to exempt them from the Hazard of it's getting into the Noſe or *Trachea*, but it's ſharp Points would hurt an *Uvula*, or *Epiglottis*, if they had any. Hence we ſee with what Difficulty they ſwallow Dough or other ſort of Food that can be eaſily moulded into any Form.

Cranium.

Their *Cranium* is more *Cellular* and *Cavernous* than ours, by this Means their Heads are light, yet ſtrong enough to reſiſt external Injuries; for the enlarging the Diameter of Bones contributes to their Strength. By this *cavernous Cranium* the Organ of Smelling is conſiderably enlarged; and further, ſinging Birds, as is obſerved by Mr. *Ray* and Mr. *Derham*, have this *cavernous* Structure of the Brain ſtill more obſervable; and we are told that the Cavity of the *Tympanum* communicates with the Cells; but this I am apt to believe, ſo far as I could find from Diſſection, is rather founded on Theory than Matter of Fact. Their Brain is covered with the common *Membranes*, but it's external Surface is not formed into ſo many *Gyræ* or Convolutions as ours. It's anterior Part is quite ſolid, of a cineritious Colour, and ſo far has a Reſemblance of the *Corpora Striata*, as to give Riſe to the *Olfactory Nerves*. The whole of it appears to us as imperfect, and we can ſcarce determine whether there be any Thing analogous to a third or fourth Ventricle; neither the *Corpus Calloſum*, *Fornix*, *Nates*, or *Teſtes*, &c. can be obſerved here; which Parts therefore cannot be imagined as abſolutely neceſſary for the Functions of Life, ſince we find theſe Creatures perform them ſufficiently well. We may perhaps think theſe ſerve a particular Uſe in Man, who is a rational Creature, but then *Quadrupeds* enjoy them in common with Man. Theſe Protuberances, *&c.* ſeem rather to depend on the different Diſpoſition of the ſeveral Parts, being variouſly connected and meeting in different Directions in different Places, than their being abſolutely neceſſary for any particular Uſe, and the Uſes that have been aſſigned to different Parts of the Brain by Authors, ſeem to me to have no Foundation but in the Author's Fancy. I have already owned my Ignorance of the Uſes of the particular Parts of the Brain, ſo ſhall not pretend to give Reaſons for their being different in different Animals, but all ſeem to agree in this, that the *Cerebrum* has always Hollows and Vacuities in it, but the *Cerebellum* none.

The Organ of Smelling. Their Organ of Smelling is very large and well provided with Nerves; hence they have this Senſation very acute. Ravens and other Birds of Prey give a ſure Proof of this by their being able to find out their Prey though concealed from their Sight, and at a conſiderable Diſtance.

Thoſe Birds that grope for their Food in the Waters, Mud, *&c.* have large Nerves which run quite to the End of their Bills, by which they find out and diſtinguiſh their Food.

Eye. The anterior Part of their Eyes (inſtead of having the *Sclerotic* Coat continued, ſo as to make near a Sphere as in us) turns all of a ſudden flat; ſo that here the *Sclerotic* makes but half a Sphere; and the *Cornea* riſes up afterwards, being a Portion of a very ſmall and diſtinct Sphere; ſo that in theſe Creatures there is a much greater Difference betwixt the *Sclerotic* and *Cornea* than in us. Hence their Eyes do not jut out of their Heads as in Man and *Quadrupeds*. As moſt of theſe Creatures are continually employed in Hedges and Thickets, therefore that their Eyes might be ſecured from theſe Injuries, as well as from too much Light when flying in the Face of the Sun, there's a very elegant Mechaniſm in their Eyes, which is a *Membrane* riſing from the internal *Canthus* of the Eye, which at Pleaſure, like a Curtain, can be made to cover the whole Eye, and this by Means of a proper Muſcle that riſes from the *Sclerotic* Coat and paſſing round the *Optic Nerves* runs through the *Muſculus Oculi Attollens* (by which however the *Optic Nerves* are not compreſſed) and *Palpebra* to be inſerted into the Edge of this *Membrane*. Whenever this Muſcle ceaſes to act, the *Membrane* by it's own Elaſticity again diſcovers the Eye. This Covering is neither *Pellucid* nor *Opaque*, both which would have been equally inconvenient, but being ſomewhat tranſparent, allows as many Rays to enter as to make any Object juſt viſible, and is ſufficient to direct them in their Progreſſion. By Means of this *Membrane* it is that the Eagle is ſaid to look at the Sun. *Quadrupeds*, as we mentioned before, have a *Membrana Nictitans*, but then it only can cover that Part of the Eye which is never covered by their Eye-lids.

Bourſe Noire. It's Deſcription and Uſes.

Beſides, all Fowls have another Particularity, whoſe Uſe I think is not ſo well underſtood, and that is a pretty long black triangular Purſe riſing from the Bottom of their Eye juſt at the Entry of the *Optic Nerve*, and ſtretched out into their vitreous Humour, and one would imagine it gave ſome Threads to the Cryſtalline. This the *French* (who, as far as I know, were the firſt who took Notice of it in their Diſſections before the Royal Academy) give the Name of *Bourſe Noire* to. This may poſſibly ſerve to ſuffocate ſome of the Rays of Light, that they may ſee Objects more diſtinctly without hurting their Eyes. It has a Connection with the Vitreous, and ſeems to be joined alſo to the Cryſtalline Humour. If we ſuppoſe it to have a Power of Contraction, (which may be as well allowed as that of the *Iris*) it may ſo alter the Poſition of the Vitreous and Cryſtalline Humours, that the Rays from any Body may not fall perpendicularly upon the Cryſtalline; and this ſeems to be neceſſary in them, ſince they cannot change the Figure of the anterior Part of their Eye ſo much as we can do; and as this Animal is expoſed often to too great a Number of Rays of Light, ſo they having no *Tapetum*, have the Bottom of their Eye wholly black on the *Retina*, and in Conſequence of this Fowls ſee very ill in the Dark.

Organ of Hearing.

They have no external Ear, but in Place thereof a Tuft of very fine Feathers covering the *Meatus Auditorius*, which eaſily allow the Rays of Sound to paſs them, and likewiſe prevent Duſt, or any Inſect from getting in. An external Ear would have been inconvenient in their paſſing through Thickets and in flying, *&c.* A Liquor is ſeparated in the external Part of the Ear or *Meatus Auditorius* to lubricate the Paſſage, and further prevent the Entrance of any Inſects, *&c.* The *Membrana Tympani* is convex externally, and no Muſcles are fixed to the Bones of their Ear, which are rather of a Cartilaginous Conſiſtence; any tremulous Motions impreſſed on the Air are communicated in theſe Creatures, merely by the Spring and Elaſticity of theſe Bones, ſo probably the *Membrane* is not ſo diſtended as in the human Ear, where this is done by Muſcles. The *Cochlea* and *Semicircular Canals* are very diſtinct and eaſily prepared.

The Anatomy of a Carnivorous Fowl.

WE come next to the Birds of Prey, and for an Example ſhall take a Stenhil. The principal Difference to be obſerved in them, is in their *Chylopoietick Viſcera*, which may be accounted for from their different Way of Life.

Ingluvies.

Immediately under their *Clavicles*, you will obſerve the *Oeſophagus* expanded into their *Ingluvies*, which is proportionally leſs than in the *Granivorous* Kind, ſince their Food does not ſwell ſo much by Maceration, and for the ſame Reaſon there is a leſs Quantity of a *Menſtruum* to be found here.

Ventriculus Succenturiatus.

They have alſo a *Ventriculus Succenturiatus* plentifully ſtored with Glands, ſituated immediately above their Stomach, which we ſee here is evidently *membranous*, otherwiſe than in the *Granivorous* Kind, and this Difference, which is almoſt the only one we ſhall find betwixt the two different Species of Fowls, is eaſily accounted for from the Nature of their Food, which requires leſs Attrition, being eaſier of Digeſtion than that of the other Kind; nevertheleſs it ſeems requiſite it ſhould be ſtronger than the human, to compenſate the want of *Abdominal* Muſcles, which are here very thin.

Inteſtina. The ſame Mechaniſm obtains in this Creature's *Duodenum*, that we have hitherto obſerved. As being a *Carnivorous* Animal it's Guts are proportionally ſhorter than thoſe of the *Granivorous* Kind, for the Reaſon firſt given, *viz.* it's Food being more liable to corrupt, therefore not proper to be long detained in the Body, and for that Reaſon it has no *Inteſtina Cæca*, of which the other Species of Fowls have a Pair. The Difference in their Wings, Backs, and Claws are obvious, and have been already in ſome Meaſure obſerved.

There is a full Deſcription of the different Parts of the Egg, with the Changes that happen in the Time of Incubation, in the ſecond Volume of the *Medical Eſſays*.

The

The Anatomy of Fiſhes.

AQueous Animals are generally divided into ſuch as have Lungs, and ſuch as want them. The firſt Species differ very inconſiderably from an Ox or any other *Quadruped*, and are not eaſily procured, ſo that all I have to ſay on Fiſhes, ſhall be taken from that Species, which is not provided with Reſpiratory Organs.

Cuticula, Likeneſs to the human.

Of theſe we may firſt obſerve, that they have a very ſtrong thick *Cuticle* compoſed evidently of a great Number of Scales laid one on another like the Tiles of Houſes; this among other Arguments ſerves to prove the human *Epidermis* to be of a ſquamous Structure. In the next Place theſe Creatures have neither anterior nor poſterior Extremities, as *Quadrupeds* and Fowls: for their Progreſſion is performed in a different Way from either of theſe Species of Animals; for this Purpoſe they are provided with Machines

Swiming, how performed. Several Uſes of their Fins, Tail, Air Bags, &c.

Machines properly conſiſting of a great Number of elaſtic Beams, connected to one another by firm *Membranes*, and with a Tail of the ſame Texture; their *Spine* is very moveable towards the poſterior Part, and the ſtrongeſt Muſcles of their Bodies are inſerted there. Their Tails are ſo framed as to contract to a narrow Space when drawn together to either Side, and to expand again when drawn to a ſtreight Line with their Bodies, ſo by the Aſſiſtance of this broad Tail, and the Fins on their Sides, they make their Progreſſion much in the ſame Way as a Boat with Oars on it's Sides and Rudder at it's Stern. The perpendicular Fins ſituated on the ſuperior Part of their Body keep them in *Æquilibrium*, hindering the Belly from turning uppermoſt, which it would readily do, becauſe of the Air Bag in the *Abdomen* rendering their Belly ſpecifically lighter than their Back, but by the Reſiſtance theſe Fins meet with when inclined to either Side, they are kept with their Backs always uppermoſt.

moſt. The beſt Account of this Matter we have in the Treatiſe before mentioned, *viz. Borelli de Motu Animalium*, Part I. Chap. 23.

It may be next obſerved, that theſe Creatures have nothing that can be called a Neck, ſeeing they ſeek their Food in an horizontal Way, and can move their Bodies either upwards or downwards as they have Occaſion by the Contraction or Dilatation of their Air Bag; a long Neck, as it would hinder their Progreſſion, would be very diſadvantageous in the Element they live in.

The *Abdomen* is covered on the inferior Part with a black-coloured thin *Membrane* reſembling our *Peritoneum*. It is divided from the *Thorax* by a thin *Membranous* Partition which has no muſcular Appearance, ſo that we have now ſeen two different Sorts of Animals that have no muſcular *Diaphragm*.

Teeth, for what made. Theſe Creatures are not provided with *Teeth* proper for breaking their Aliment into ſmaller Morſels, as the Food they uſe is generally ſmall Fiſhes or other Animals that need no Trituration in the Mouth, but ſpontaneouſly corrupt and gradually diſſolve into a liquid *Chyle*. Their *Teeth* ſerve to graſp their Prey and hinder the Creatures they have once catched from eſcaping again. For the ſame Purpoſe the internal *Cartilaginous* Baſis of the *Bronchi*, and the two round Bodies ſituated in the poſterior Part of the Jaws, have a great Number of Tenter-hooks fixed into them in ſuch a Manner, as that any Thing can eaſily get down, but is hindered to get backwards. The Water that is neceſſarily taken in along with their Food in too great Quantities to be received into their Jaws in Deglutition, paſſes betwixt the *Interſtices* of the *Bronchi*, and the Flap that covers them. The Compreſſion of the Water on the *Bronchi* is of conſiderable Uſe to the

Creature, as we ſhall explain by and by.

The *Oeſophagus* in theſe Creatures is very ſhort, and ſcarcely diſtinguiſhed from their Stomach, ſeeing their Food lies almoſt equally in both. The Stomach is of an oblong Figure. There are commonly found ſmall Fiſhes in the Stomach of large ones, ſtill retaining their natural Form, but when touched they melt down into a Jelly. From this and the great Quantity of Liquors poured into their Stomachs, we may conclude that Digeſtion is ſolely brought about in them, by the diſſolving Power of a *Menſtruum*, and that no Trituration happens here.

Digeſtion performed ſolely by a Menſtruum.

The Guts in theſe Animals are very ſhort, making only three Turns, the laſt of which ends in the common *Cloaca* for the *Fæces*, *Urine* and *Semen*, ſituated about the Middle of the inferior Part of their Bodies.

Inteſtina.

What

Pancreas.

What I call *Pancreas*, ſome gave the Name of *Inteſtinula Cæca* to; it conſiſts of a very great Number of ſmall Threads, like ſo many little Worms, which all terminate at laſt in two larger Canals, that open into the firſt Gut, and pour into it a viſcous Liquor, much about the Place where the *Biliary Ducts* enter. Their *Inteſtines* are connected to the Back-bone by a *Membrane* analogous to a *Meſentery*. No *Lacteals* have been yet obſerved, and it's probable their Aliment is taken in by the *Meſeraic* Veins.

Their Liver is very large, of a whitiſh Colour, and lies almoſt in the Left-ſide wholly, and contains a great deal of Fat.

ver, all-ladder, d their ucts.

The Gall-Bladder is ſituated a conſiderable Way from the Liver, and ſends out a Canal, the *Cyſtic Duct*, which joins with the *Hepatic Duct* juſt at the Entry into the Gut; ſome Fibres are ſtretched from the Liver to the Gall-Bladder, but none that I know of have hitherto diſcovered any Cavity in theſe Cords; ſo in this Animal it ſhould ſeem impoſſible that the *Bile* can be carried into the Gall-Bladder in the ordinary Way, and conſequently muſt either be ſecerned on the Sides of that *Sac*, or regurgitate into it from the *Canalis Choledochus*.

Spleen, it's Uſe drawn from Analogy.

The *Spleen* is placed near the Back-bone, and at a Place where it is ſubjected to an alternate Preſſure from the Conſtriction and Dilatation of the Air-Bag, which is ſituated in the Neighbourhood. Since in all the different Animals we have diſſected, we find the *Spleen* attached to ſomewhat that may give it a Conquaſſation, as in the human Subject and *Quadrupeds*, it is contiguous to the *Diaphragm*, in Fowls it is placed betwixt the Back-bone, the Liver and Stomach, in Fiſhes it lies on the *Saccus aerius*, and ſince we find it ſo well ſerved with Blood Veſſels, and all it's Blood returning into the Liver; we muſt not conclude the *Spleen* to be an *inutile Pondus*, only to ſerve as a Balance to the Animal *pro æquilibrio*, but particularly deſigned for preparing the Blood to the Liver.

Organs of Generation. The only Organs of Generation in this Animal are two menſtruous Bags ſituated in the *Abdomen* uniting near the *Podex*. Theſe in the Male are filled with a whitiſh firm Subſtance called the *Milt*, and in the Female with an infinite Number of little *Ova* cluſtered together, of a reddiſh yellow Colour called the *Roe*. Both theſe at Spawning Time we find very much diſtended, whereas at another Time the Male Organs can ſcarce be diſtinguiſhed from the Female, nor is there any proper Inſtrument in the Male for throwing the Seed into the Organs of the Female as in other Creatures. I ſhall not take upon me to determine the Way whereby the Female Sperm is impregnated, but we find that the Spawn of Frogs conſiſts in the ſmall Specks wrapt up in a whitiſh glutinous Liquor; theſe Specks are the Rudiments of the young Frogs which are nouriſhed in that Liquor, till they are able to go in Search of their Food. In the ſame Way the *Ova* of Fiſhes are thrown out and depoſited in the Sand, the Male being for the moſt Part ready to impregnate them, and they are incubated by the Heat of the Sun. It is curious enough to remark with what Care they ſeek for a proper Place to depoſite their *Ova*, by ſwimming to the Shallow, where they can better enjoy the Sun's Rays, and ſhun the large Jaws of other Fiſhes. The River Fiſhes again ſpawn in ſome Creek free from the Hazard of the impetuous Stream. But whether this Mixture be brought about in Fiſhes by a ſimple Application of the Genitals to each other, or if both of them throw out their Liquors at the ſame Time in one Place, and thus bring about the deſired Mixture, is not eaſy to determine; the latter, I think, ſeems moſt probable. Theſe Creatures are ſo ſhy that we cannot poſſibly get to obſerve their Way of Copulation, and are conſequently but little acquainted with their natural Hiſtory.

The Air-Bladder, and it's Uſes.

After raiſing up the black *Peritoneum*, there comes in View an oblong white membranous Bag, in which there is nothing contained but Air. This is the Swimming-bladder; it lies cloſe to the Back-bone, and has a pretty ſtrong muſcular Coat, whereby it can contract itſelf. By contracting this Bag, they can make the Muſcles ſpecifically heavier than water and ſo readily fall to the Bottom; whereas the *muſcular Fibres* ceaſing to act, they become ſpecifically lighter than Water and ſo ſwim above. According to the different Degrees of Contraction and Dilatation of this Bladder, they can keep higher or lower in the Water at Pleaſure. Hence Flounders, Soles, Raia, and ſuch other Fiſhes as want this *Sac*, are found always groveling at the bottom of the Water: it is owing to this that dead Fiſhes (unleſs this *Membrane* has been previouſly broke) are found ſwimming a Top, the *muſcular Fibres* then ceaſing to act, and that with their Bellies uppermoſt; for the Back-bone cannot yield, and the diſtended *Sac* is protruded into the *Abdomen*, and the Back is conſequently heavieſt at it's upper Part according to their Poſture. There is here placed a glandular Subſtance containing a good Quantity of red Blood, and all the *Red* in their Body is contiguous to this Air Bag, excepting the Guts. From the anterior Part of the Bag go out two *Proceſſes* or *Appendices*, which, according to the Gentlemen of the *French Academy*, terminate in their Fauces: but I never could find out this Communication either by tracing them, pouring in Mercury or Water, &c. I put it is true a Probe through them, but then with the ſame Strength I could have put it through the Sides of the *Proceſſes*, ſo that I am afraid this is *gratis Dictum*, and that there is here as in ſome other Places of the human Body an *Aer Inſitus*.

It's Proceſſus, or Communication with the Venticulus.

Ureters. Veſica Urinaria. Urethra.

At the ſuperior Part of this Bag there are other *Red* coloured Bodies, of a glandular nature which are connected with the Kidneys. From them the *Ureters* go down to their Inſertion in the *Veſica Urinaria*, which lies in the lower Part of the *Abdomen*, and the *Urethra* is there produced which terminates in the *Podex*.

Diaphragm.

Theſe laſt mentioned parts have not hitherto been obſerved in ſome Species of Fiſhes, whence Authors too haſtily denied them in all. Theſe Creatures have a *membranous Diaphragm* which forms a *Sac*, in which the Heart is contained. It is very tenſe and almoſt perpendicular to the *Vertebrae*.

The Heart has but one Auricle *and one* Ventricle.

The Heart is of a triangular Form with it's Baſe downwards, and it's *Apex* uppermoſt, which Situation it has becauſe of the *Branchiae*. It has but one *Auricle* and one *Ventricle*, becauſe they want Lungs; and one great Artery. The Size of the *Auricle* and *Ventricle* are much the ſame; the Artery ſends out numberleſs Branches to the *Branchiae* or Gills.

The Branchiæ. Their Structure, and Uſe.

The *Branchiae* lye in two large Slits at each Side of their Heads, and ſeem to be all they have that bears any Analogy to Lungs. Their Form is Semi-circular, they have a vaſt Number of *red Fibrillae* ſtanding out on each Side of them like a Fringe, and very much reſemble the Vane of a Feather. Theſe *Branchiae* are perpetually ſubjected to an alternate Motion and Preſſure from the Water; and we may here remark, that we have not found any *red* Blood but in Places ſubjected to this alternate Preſſure; this Obſervation will help us in explaining the Action of the Lungs upon the Blood. Over theſe Gills there is a large Flap, allowing a Communication externally, by which the Water they are obliged to take into their Mouths with their Food, finds an Exit without paſſing into their Stomach; it's owing to theſe Flaps coming ſo far down that the Heart is ſaid commonly to be ſituated in their Heads.

Cerebrum. Their Brains are formed pretty much in the ſame Way as that of Fowls, only we may obſerve that the Poſterior Lobes bear a greater Proportion to the anterior.

Organ of Smell. Their Organ of Smelling is large, and they have a Power of contracting and dilating the Entry into their Noſe as they have Occaſion. It ſeems to be moſtly by their acute Smell that they diſcover their Food; for their Tongue ſeems not to have been deſigned for a very nice Senſation, being of a pretty firm cartilaginous Subſtance, and common Experiment evinces, that their Sight is not of ſo much Uſe to them as their Smell in ſearching for their Nouriſhment. If you throw a freſh Worm into the Water, a Fiſh ſhall diſtinguiſh it at a conſiderable Diſtance, and that this is not done by the Eye, is plain from obſerving, that after the ſame Worm has been a conſiderable Time in the Water and loſt it's Smell, no Fiſhes will come near it: but if you take out the Bait and make ſeveral little Inciſions into it ſo as to let out more of the odoriferous Effluvia, it ſhall have the ſame Effect as formerly. Now it is certain, had the Creatures diſcovered this Bait with their Eyes, they would have come equally to it in both Caſes: In Conſequence of their Smell being the principal Means they have of diſcovering their Food, we may frequently obſerve their allowing themſelves to be carried down with the Stream that they may aſcend again leiſurely againſt the Current of the Water; thus the odorous Particles ſwimming in that Medium, being applied more forcibly to their ſmelling Organs, produce a ſtronger Senſation.

The *Optic Nerves* in theſe Animals are not confounded with one another in their middle Progreſs betwixt their Origin and the Orbit, but the one paſſes over the other without any Communication, ſo that the Nerve that comes

Optic Nerves.

comes from the Left-ſide of the Brain goes diſtinctly to the Right-eye: And *vice verſa.*

The Cryſtallin Humour a compleat Sphere, and why.

The *Lens Cryſtallina* is here a compleat Sphere, whereas in Men and all other Terreſtrial Animals it conſiſts of two Portions of unequal Spheres laid on one another; to account for this, it muſt be conſidered that theſe Creatures have got no Aqueous Humour, as the Rays that come to their Eyes are conveyed through a *Medium* of the ſame Denſity with that Humour in other Animals, and conſequently would have gone on in a ſtreight Line without any Refraction till they came to the *Lens,* although they had been provided with an Aqueous Humour; thus then the Rays impinging upon their *Lens* have hitherto ſuffered no Refraction; that they might therefore be ſufficiently refracted and meet in a Point on the *Retina,* it was neceſſary the *Lens* ſhould be made more convex than it is in other Creatures who have the Rays conſiderably refracted in their Paſſage from the Air through the aqueous Humour.

As Fiſhes are continually expoſed to Injuries in the uncertain Element they live in, and as they are in perpetual Danger of becoming a Prey to the larger ones, it was neceſſary their Eyes ſhould never be ſhut, and in Conſequence of this they are not provided with *Palpebræ*; but then as in the Current itſelf the Eye muſt be expoſed to ſeveral Injuries, there was a Neceſſity it ſhould be ſufficiently defended, which in Effect it is by a firm *Pellucid Membrane* that ſeems to be a Continuation of the *Cuticula*, being ſtretched over here. The *Epidermis* is very proper for this Purpoſe, as being inſenſible and deſtitute of Veſſels, and conſequently not liable to Obſtructions or by that Means of becoming opake.

Fiſhes, if they hear or not.

Whether Fiſhes have a Senſe of Hearing or not is very uncertain: All that has the Appearance of an Organ of Hearing in theſe Creatures is a Bone, about the Bulk of one half of a common Bean of a particular Structure, being very brittle and compoſed of a great many different *Segments* laid at one another's Sides, and ſituated in a particular Form at the Side of the Brain; is then the Idea of Sound communicated to them by Means of this Bone? Or does their running away, at ſtamping hard on the Ground or crying loud, depend upon ſome other kind of Senſation? This may poſſibly be produced in them, by a tremulous Motion communicated to their Bodies by the circumambient Water, which is put in Agitation, from the like Concuſſions happening in the Air or neighbouring Ground.

FINIS.

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